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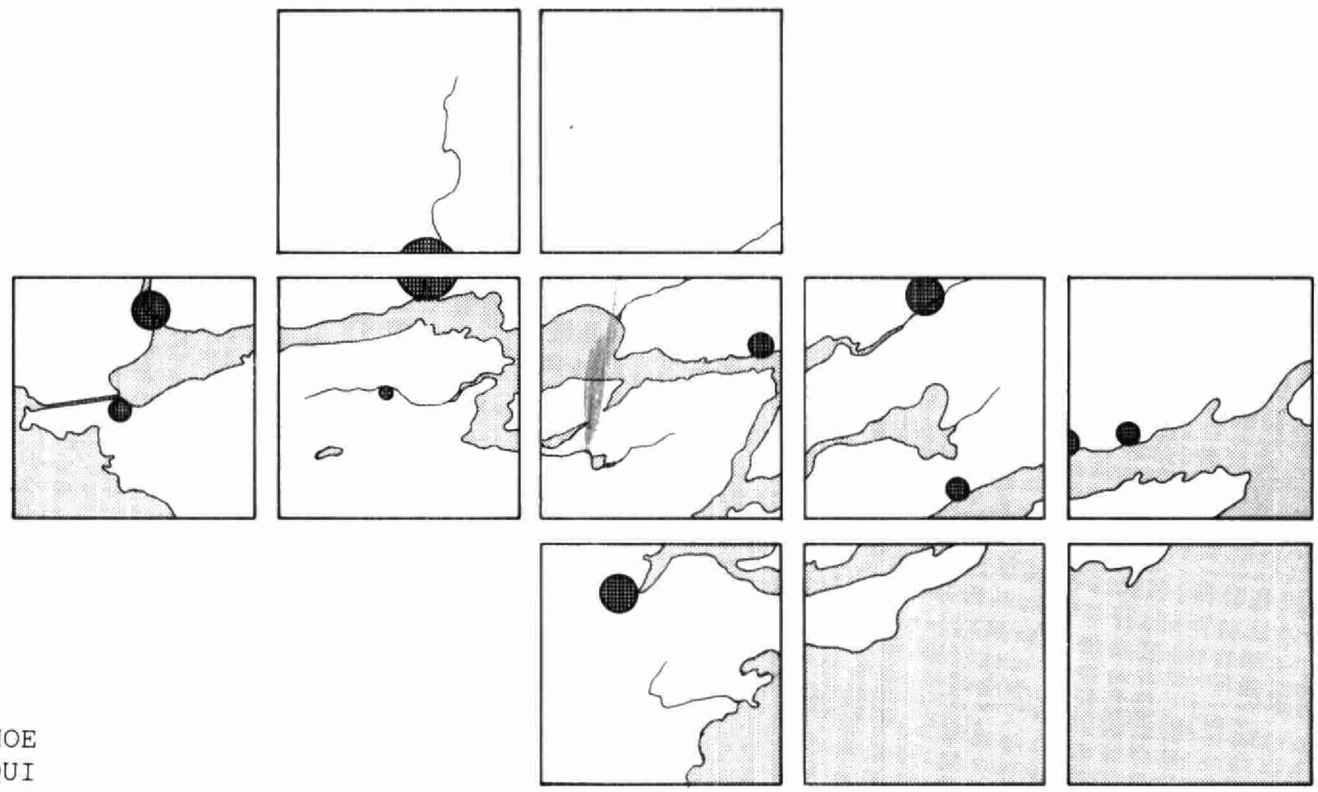
Bay of Quinte Remedial Action Plan

An Evaluation of Persistent Toxic Contaminants in the Bay of Quinte Ecosystem



Technical Report No. 1

BAY OF QUINTE REMEDIAL ACTION PLAN

AN EVALUATION OF PERSISTENT TOXIC CONTAMINANTS IN THE BAY OF QUINTE ECOSYSTEM

Prepared for:

The Bay of Quinte RAP Coordinating Committee

By:

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FOREWORD

In its 1985 report to the International Joint Commission (IJC), the Great Lakes Water Quality Board recommended that the appropriate jurisdictions prepare and submit detailed Remedial Action Plans (RAPs) for the restoration of beneficial uses of 42 identified 'Areas of Concern' on the Great Lakes System. The Bay of Quinte is one of the IJC identified 'Areas of Concern'.

The process of developing a RAP for the Bay of Quinte was initiated in 1986 with the formation of a Federal/Provincial Coordinating Committee to oversee preparation of the RAP.

The Coordinating Committee in its February, 1987, Progress Report defined excessive nutrient enrichment, persistent toxics and bacteriological contamination as the factors responsible for the impairment of Bay of Quinte beneficial uses. It also identified technical data gaps and a list of potential options which required study.

This is one of a series of follow-up technical reports. It provides information concerning the status of persistent toxic contaminant in the Bay of Quinte ecosystems and a cursory evaluation of the sources of these contaminants.

The study was undertaken for the purpose of assembling and interpreting the available information pertaining to persistent toxic contaminants in the bay's water, sediments and biota. The report provides a good overview of this information and will serve as a useful reference document in preparing the Bay of Quinte RAP. As anticipated, however, this review has shown that the available information pertaining to toxics in the bay is inadequate. Further field work is required and being planned for 1988.

March, 1988
Bay of Quinte RAP Coordinating Committee

SUMMARY

Published and unpublished data on persistent toxic contaminants in the Bay of Quinte and its tributaries were collected from the scientific literature, and from federal and provincial scientists who have studied this area over the past 20 years. Data were tabulated in computer data files to facilitate data manipulation and synthesis. The data were compared to existing criteria for drinking water, protection of aquatic life, fish consumption and dredge spoil disposal, as well as, to 'background' toxic contaminant concentrations in Lake Ontario. Percent exceedence of criteria and maximum concentrations in relation to known toxic levels were used to identify problems areas within the Bay of Quinte, potential sources of contaminants, and long-term trends in toxic contaminant concentrations in water, sediment and biota.

Available data on persistent toxic contaminants in the Bay of Quinte ecosystem pertain primarily to tributaries and potential point sources. Data reflecting impact on the Bay as a whole are sparse and inconclusive.

Based on exceedence of water quality, dredged spoil disposal and fish consumption guidelines, (1) phenol, pentachlorophenol and heavy metal in water, (2) heavy metals and PCB in sediments, and (3) PCB, mirex, mercury and DDT in fish have been identified in some years as specific concerns.

Water quality trends toward reduction of phenols and heavy metals in tributaries, and trends to reduction of mercury, PCB, and DDT in some species of fish are evident. Sediment data are insufficient for assessment of long-term trends.

Potential sources of phenolics include Trent Valley Paperboard and Domtar Wood Preserving and Packaging plants on the Trent River, the Bakelite plant on the Bay of Quinte at Belleville, the Picton landfill, and the Trenton, Belleville and Picton Water Pollution Control Plants. Domtar and Bakelite are also associated with iron inputs and, possibly, PCB in sediments. Sewage treatment plants at Trenton, Belleville, Deseronto, Napanee and Picton appear to act as heavy metal sources. Several mining sites (past and present)

within the watershed act as heavy metal sources to the Bay. Some landfill sites possibly may represent contaminant sources; however, further work is needed to measure the potential and categorize the sites.

A comprehensive gird survey of water and sediment quality throughout the Bay of Quinte proper is needed to assess potential impacts of persistent toxic contaminants on the Bay of Quinte ecosystem. Concurrent evaluation of the benthic community in terms of density, diversity and contaminant bioaccumulation would provide evidence of the ecosystem health status.

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

Primarily because of elevated densities of coliform bacteria, as well as, the occurrence of nuisance aquatic plant growth, the Great Lakes Water Quality Board (GLWQB) of the International Joint Commission (IJC), since 1973, has identified the Bay of Quinte as a problem area. The GLWQB (1976) reported that investigations carries out by the MOE in 1972 showed that the IJC objectives for total and fecal coliform bacteria (1,000 total coliforms per 100 mL H_2O and 200 fecal coliforms per 100 mL H_2O respectively) were violated during the summer months near Trenton, Belleville, Deseronto and Picton. Furthermore, a gradient occurs from extreme eutrophy in the Upper Bay to mesotrophy near the bay mouth. High chlorophyll levels were found at Trenton, Belleville, Hay Bay, Picton and Glenora. Total phosphorus concentrations exceeded 1.0 mg L^{-1} near Trenton and Belleville.

In 1979, the GLWQB (1979a, b) confirmed that the Bay of Quinte/Adolphus Reach was a problem area where the water quality objectives for dissolved oxygen (>6 mg L^{-1}), and the eutrophication status remained unchanged due to, in part, incomplete remedial programs. The major sources of biological oxygen demand (BOD) and phosphorus were identified

as Domtar Packaging in Trenton, Trent Valley Paperboard in Glen Miller and the Belleville Sewage Treatment Plant (STP). It was anticipated that achievement of effluent requirements would correct the problem.

In 1980, the GLWQB (1980a, b) reported that the Bay of Quinte had shown substantial improvement, but surveillance would continue until the water quality objectives had been met fully. Phosphorus levels and algal blooms decreased significantly, in part, as a result of phosphorus controls implemented in 1978. Turbidity was lower, and the densities of algae collected weekly at the Belleville water intake were 50 to 60% lower in 1979 than those recorded in 1978. However, dissolved oxygen levels, a measure of the degree of eutrophication, were poor. In the Adolphus Reach area in 1979 the oxygen levels were generally about 4 mg L^{-1} and fell slightly below 3 mg L^{-1} in the deepest portions of the bay. It was hypothesized that oxygen in Adolphus Reach may not decrease from present levels and, in fact, could improve as a result of the phosphorus removal program.

In 1981, the GLWQB (1981a, b) reported that the bay has exhibited a good response to phosphorus controls. Yet, phosphorus abatement measures have had little impact thus far

on the low (1 to 2 mg L^{-1}) dissolved oxygen levels in the Adolphus Reach area. Surveillance of the enrichment status was to be continued for the entire bay to determine the need for and efficacy of additional control measures.

In addition, the GLWQB (1981a, b) reported that PCBs were measured in rainbow smelt (>20 cm) and larger specimens of smallmouth bass (>45 cm) necessitating a consumption limitation. Also, elevated mercury levels measured in walleye (>45 cm), northern pike (>65 cm), largemouth bass (>35 cm) and smallmouth bass (>30 cm) resulted in consumption advisories for these species.

Domtar Packaging was found to in compliance with the Ministry of the Environment (MOE) loading requirements for phosphorus, BOD and suspended solids, but not with the requirement for phenolic substances. Trent Valley Paperboard met MOE loading requirements for phosphorus, BOD and suspended solids. Lastly, the STPs at Belleville, Trenton, Napanee, Picton, Deseronto, Frankford, Stirling and Sidney Township (Batawa) were required to by the MOE to lower the total phosphorus in their effluent to 0.5 mg L^{-1} during the summer months.

In 1985, the GLWQB (1985) summarized the types of problems in

the Bay of Quinte as conventional pollutants and eutrophication. Sources of the problems were listed as municipal point sources, industrial point sources, and urban and agricultural non-point inputs. Despite reductions in phosphorus loadings, dissolved oxygen levels remain low in Adolphus Reach and eutrophication still exists. As well, zones of intermittently elevated bacterial levels occur at Trenton, Belleville and Picton as a result of stormwater discharges. Completed and ongoing remedial actions included:

- completion of the Belleville STP expansion;
- restrictive phosphorus effluent controls in place;
- investigations to define local bacterial problems and possible remedial actions;
- activated carbon treatment system to remove pentachlorophenols (PCP) from wood preserving plant effluent; and,
- regular waste source and ambient monitoring.

Most recently, the GLWQB (1985) recommended that the Remedial Action Plan (RAP) be submitted for the Bay of Quinte. A federal-provincial Coordinating Committee was established in 1986 to develop the plan. As part of this effort, a review and evaluation of the current status of persistent toxic contaminants in the Bay of Quinte ecosystem was conducted. The findings of that undertaking are presented herein.

2.0 STUDY APPROACH AND OBJECTIVES

2.1 Study Objectives

The purpose of this study was to:

(1) complete a comprehensive review of existing data on persistent toxic contaminants in the Bay of Quinte ecosystem;

(2) evaluate the environmental significance of these contaminants; and,

(3) to identify data deficiencies, as well as, potential contaminant sources.

While nutrients and eutrophication have received considerable attention and review (eg., Minns et.al., 1986), toxic contaminants have received less emphasis. The purpose of this study, as outlined above, was to assemble and synthesize information collected over the past 20 years on persistent toxic substances in the Bay of Quinte water, sediments and biota.

2.2 Study Approach

A workplan was devised to meet the project objectives. It consisted of the following tasks:

- literature and database search;
- data tabulation and summary;
- data review and evaluation;
- trend-in-time analysis;

- identification of data deficiencies; and,
- identification of potential contaminant sources.

The literature and database was searched for entries on persistent toxic contaminants in the Great Lakes. These sources were updated by direct communication with federal and provincial environment ministries to identify and locate more recent publications and unpublished data sets. In this manner, all identified data pertaining to persistent toxic contaminants in the Bay of Quinte water, sediment and fish were obtained. The data were tabulated in Lotus spreadsheet to facilitate data manipulation and synthesis.

A large quantity of tributary monitoring data was downloaded from the MOE SIS database (MOE, 1973-87), and this information further reduced to means and standard deviations of each chemical parameter, year and sampling station. Stations nearest the tributary mouths were selected as the appropriate indicators of contaminant concentrations entering the Bay and concentration trends over time.

Data review and evaluation of environmental significance included comparison of contaminant concentrations to existing criteria for protection of aquatic life and human health.

These are listed in Appendix Table A1.1. For each chemical parameter, year and Bay of Quinte location the annual contaminant mean, standard deviations, maxima and percent exceedence of pertinent criteria were determined (see Table 3.2). For computation of means, samples reported as "Less than Detection" were considered equal in concentration to the detection limit.

Environmental criteria for drinking eater, protection of aquatic life, fish consumption and dredged spoil disposal were taken, in order of preference, from MOE (Persaud and Wilkins, 1975, dredge spoil disposal; MOE, 1984a, drinking water, aquatic life), Health and Welfare Canada (1987, fish consumption), the World Health Organization (1984, drinking water), the IJC (1978, 1980, 1981, 1983a, 1985, aquatic life) or the U.S. Environmental Protection Agency (1976, 1980, drinking water, aquatic life). Since parts of Persaud and Wilkins (1975) are currently under review, a comparison to Lake Ontario 'background' sediment concentrations from Mudroch, et.al. (1986) was also performed.

Trend-in-time analysis consisted of plotting annual mean contaminant concentrations against year of measurement for each chemical parameter and location where criterion

exceedences had occurred. For most parameters and locations there was insufficient quantity or continuity of data to justify statistical testing of particular trend models. However, where data were sufficient to suggest either an increasing of decreasing trend, the trend-in-time plot was presented and discussed.

2.3 Study Area

The Bay of Quinte is a large body of water (254 km^2) used for industrial and drinking water supplies, wastewater disposal, recreational swimming, boating and angling.

Study area locations are shown in Figure 2.1. These identify receiving water, point source (effluent), sediment and fish sampling areas. Some of these areas include a number of more specific sampling stations which are identified in the tabulated data files. However for data evaluation and synthesis, the locations shown in Figure 2.1 represent the greatest degree of spatial resolution considered.

The sampling locations plus the environmental media sampled at each location are listed in Table 2.1. Specific details

on date of sampling, number of stations, chemical parameters measured, and sources of data at each locations are presented in Sections 3.1, 4.1, and 5.1, respectively for water, sediment and biota.

3.0 PERSISTENT TOXIC CONTAMINANTS IN WATER

3.1 Extent of the Database

In 1968, the Department of National Health and Welfare conducted a study of pesticide residues in water and fish of the St. Lawrence River and Bay of Quinte (Wong and Donnelly, 1968). Relatively high levels of DDT were noted in all five water samples and some fish from the Bay of Quinte. Because of analytical uncertainties, these data were not included in the database.

MOE water quality monitoring at fixed stations along each of the Trent, Moira, Salmon and Napanee Rivers, and Millhaven, Picton, Picton Marsh, Demorestville and Sawguin Creeks has been ongoing since 1973 (MOE, 1973-87). Also, Project Quinte was initiated in 1972 to monitor the water quality and ecosystem status of the bay in relation to phosphorus loadings. These loadings were reduced by 50% in 1978, and phosphorus concentrations have declined by about 35% since that time.

In 1977, a survey was conducted by the MOE to determine the effects of the effluent discharged by Trent Valley Paperboard Mills (TVP) to the Trent River (Dillenbeck, 1977). Chemical

analyses for phenolics and qualitative examinations of the river bottom at 20 stations defined an area approximately 30 m from the west bank of the Trent River extending about 1,500 m downstream for the tailrace as one of impaired water quality. This area has been designated as an 'effluent zone'.

In 1978, Fox and Joshi (1984) collected water and sediment samples throughout the Bay of Quinte for analysis of PCP and tetrachlorophenols. It was determined that concentrations of these substances in water declined with distance from the Domtar Wood Preserving Plant on the Trent River.

In 1981, a study was undertaken by the MOE to assess the impact in the Trent River of phenol and PCP concentrations entering the Trent River from the Domtar Wood Preserving site. PCP is a powerful biocide used as a wood preservative. Results of the 15 station survey indicated that the PCP concentration did not exceed MOE criteria for the protection of aquatic life (Dillenbeck, 1981a). The concentration of phenolics indicated that rapid and efficient mixing of the effluent had taken place, and that the Domtar effluent had no detrimental effects on the water quality at Trenton.

An MOE investigation in 1983 revealed that concentrations of phenolics had increased since 1981 (Dillenbeck, 1983). From a survey of 15 stations, it was concluded that the source of the increased levels of phenolics was at the Domtar Packaging site located upstream of the Domtar Wood Preserving site.

In 1985 and 1986, Domtar undertook studies of receiving water quality in the Trent River above and below the Domtar Packaging and Wood Preserving plants. Phenol was found to exceed provincial water quality objectives as far downstream as the river mouth (Naish, et.al., 1986). PCP was detected in concentrations approximately an order of magnitude lower than reported earlier by Fox and Joshi (Shariff, et.al., 1987).

In another area of the Bay, the MOE investigated, in 1980 and 1981, the impact of phenolics and iron in surface water discharges from Bakelite Thermosets, Belleville on the water quality of the Bay of Quinte (Dillenbeck, 1981b). The study defined a very limited zone of impact.

In 1982, the MOE undertook a survey of the water quality of Picton Marsh Creek and Picton Bay (Metcalfe, 1982). In

addition, an assessment was made to determine the effects of the Picton landfill site and the Water Pollution Control Plant on these surface waters. Based on a survey of 11 stations, it was concluded that channelization construction within Picton Marsh Creek contributed to abnormal surface water quality conditions, and a regular monitoring of the Water Pollution Control Plant and Prince Edward Heights Complex STP would be carried out.

In 1982, the MOE conducted a survey of organics and heavy metals in STP effluents at Trenton, Belleville, Deseronto, Napanee and Picton (MOE, 1984b).

Ontario Hydro conducted water and sedimetn quality surveys in the Bay of Quinte at Long Reach in 1976 and 1982 (Ontario Hydro, 1977, 1982). Slightly elevated concentrations of heavy metals were noted in the water following blasting activities associated with laying an underwater cable.

In 1983, the Water Qulaity Branch of Environment Canada collected water samples at 14 stations in Lake Ontario, including one station in the Bay of Quinte, for analysis of 23 organochlorine contaminants (Biberhofer and Stevens, 1987). Contaminant levels did not exceed current IJC or U.S.

EPA water quality criteria.

The data from these various studies are summarized in Table 3.1. The MOE tributary monitoring program provides the only data suitable for analysis of long-term water quality trends. The extent of data for the Bay of Quinte itself is very limited, both temporally and spatial distribution.

3.2 Evaluation of Environmental Significance

Assuming the protection of human health and aquatic life require maintenance of water contaminant concentrations below existing criteria for drinking water and aquatic life protection (see Appendix Table A1.1), contaminant concentrations of concern have been identified in most of the Bay of Quinte tributaries. Data external to the MOE tributary monitoring data (Table 3.2) show exceedence of phenolics objectives of phenol and/or PCP in the bay at Belleville and Trenton, and in the Trent River and Picton Marsh Creek. On the Trent River phenolic inputs are associated with the Trent Valley Paperboard Mills at Glen Miller and the Domtar Wood Preserving and Packaging plants at Trenton. Phenol concentrations in process waters and effluent of the Bakelite plant at Belleville have exceeded

the 96-hour LC50 for rainbow trout (5.6 to 11.3 mg L^{-1} (Verschueren, 1983)). However, no impact on the Bay of Quinte has been demonstrated.

Exceedences of heavy metal criteria (see Table 3.2) are primarily associated with STP effluents. The STP effluent samples were collected in 1982 (MOE, 1984b). As well, exceedences of heavy metal criteria occurred at Picton Marsh Creek. Iron concentrations exceeded both drinking water and aquatic life objectives at all locations except Deseronto and Picton STPs. Iron objectives were also exceeded in the Trent River (below No. 1 Dam) and the Bakelite site drainage. Copper generally exceeded only the aquatic life objective, except at Picton Marsh Creek where the higher drinking water objective was also exceeded. Zinc exceeded the aquatic life objective at the Napanee and Picton STPs, but did not exceed the higher drinking water objective. Both zinc objectives were exceeded intermittently at Picton Marsh Creek. Lead exceeded the aquatic live objective at the Napanee STP and Picton Marsh Creek, but the higher drinking water objective was exceeded only at Picton Marsh Creek. Nickel exceeded the stringent EPA drinking water objective (1.34 mg L^{-1}) at the Trenton, Belleville, Napanee and Picton STPs and in Wilton Creek, but only exceeded the higher aquatic life objective at

the Belleville STP. Since the STP effluents are not discharged near drinking water intakes, only the aquatic life objectives are pertinent.

The MOE (1973-87) tributary monitoring database contains more water quality data for Bay of Quinte for a longer period of time that the external data files summarized in Table 3.2. While the MOE monitoring does not contain data for every station in every year, it does cover a sufficient number of continuous years at most stations to permit preliminary examinations of temporal trends. A summary of this database is presented in Table 3.3, with mean concentrations for each chemical parameter and location in which long-term means have exceeded water quality objectives. Annual means are listed in Appendix Table A1.2.

Table 3.3 confirms the heavy metal problems previously suggested for most of the Bay of Quinte tributaries, and the problems with phenols suggested for the Trent and Moira Rivers and Picton Creek. In addition, it shows that criterion exceedences for phenols have occurred on most other tributaries including the Salmon and Napanee Rivers and the Sawguin and Demorestville Creeks. Moreover, Table 3.3 shows that PCB problems have occurred on the Trent and Moira

Rivers.

It is clear from Table 3.3 that there have been fewer exceedences of water quality objectives in recent years. With the exception of iron (in general), nickel (in the Sawguin, Demorestville and Picton Creeks and the Trent River), phenol (Sawguin Creek) and lead (at Picton Creek in 1984), only the objectives for protection of aquatic life have been exceeded since 1984 (In the case of iron, drinking water objectives are exceeded whenever aquatic life objectives are exceeded - the objective values are the same). In the case of nickel, the EPA objective for drinking water is much lower than the MOE objective for protection of aquatic life, and is generally exceeded when nickel is measured in tributaries. Also, the MOE cadmium objective for protection of aquatic life is still exceeded in all the Bay of Quinte tributaries in spite of recent reductions in concentration. The iron objective for protection of aquatic life is exceeded currently in the Moira River near the mouth, the Sawguin, Picton Marsh and Demorestville Creeks, and the Salmon and Napanee Rivers. The zinc is currently exceeded (1986-87) in Millhaven and Picton Creeks, as is the copper objective in Millhaven, Picton and Picton Marsh Creeks and the lead objective in the Sawguin Creek.

The phenol objective for protection of aquatic life is currently exceeded in the Trent River (1986) and recently exceeded that objective in the Sawguin, Picton and Demorestville Creeks. The Sawguin Creek mean phenol concentration for 1985 (6.89 ug L^{-1}) also exceeded the drinking water objective.

For PCB, the concentration was less that the detection limit (0.02 ug L^{-1}) for most samples, and the detection limit itself exceeds the provincial objective for protection of aquatic life. Hence, annual means cannot be compared to this objective with confidence. High proportions of tract or 'less than detection' data also characterize the database for cadmium, nickel, lead and phenolics.

The impact of tributary water quality on Bay of Quinte water is difficult to assess on the basis of the present evidence. Extensive sampling for persistent toxic contaminants in the water is needed in order to document and quantify the extent of these impacts.

3.3 Trend-in-Time Analysis

Some of the recent trends suggested by the data in Table 3.3 are illustrated in Figure 3.1 through 3.17. The trends which are apparent are uniformly decreasing, with the possible exception of copper at Millhaven Creek (Figure 3.1) where the high 1987 mean seems counter to the previous trend. It should be noted that the data for 1987 were incomplete, and thus, the calculated means for this year may be subject to change when the complete data are available.

Reductions in phenols are suggested in the Moira River. Cadmium has been reduced in the Trent, Moira, Salmon and Napanee Rivers. Zinc has been reduced in the Moira and Napanee Rivers. Copper has been reduced in the Moira and Napanee Rivers and Demorestville Creek. Nickel and lead have been reduced in the Napanee River, and iron has declined in Picton Creek. In all case, annual mean concentrations have declined steadily from above to below a provincial water quality objective.

Changes in detection limits since 1973 may contribute to apparent long-term trends for some parameters. Formal analysis of detection limit trends has not been performed. However, it can be observed that the temporal patterns of

contaminant reduction differ substantially between tributaries. This cannot be explained in terms of detection limit trends alone.

3.4 Ongoing Studies

A regular tributary monitoring program (MOE, 1973-87) has been established to monitor and regulate levels of total phenols, various organic compounds and heavy metals at:

- Trent River, Trenton;
- Moira River, Belleville;
- Salmon River, Shannonville;
- Napanee River, Napanee;
- Millhaven Creek;
- Picton Marsh Creek, Picton;
- Demorestville Creek; and,
- Sawguin Creek.

This program will continue to generate water quality data pertinent to Bay of Quinte tributaries.

4.0 PERSISTENT TOXIC CONTAMINANTS IN SEDIMENTS

4.1 Extent of the Database

Ferromanganese nodules collected in the Brothers Island in 1969 and Big Bay in 1972 were analyzed for 15 elements (Damiani, et.al., 1973). This survey was conducted to increase the understanding of the origin and composition of freshwater concentrations and their environmental significance. Damiani, et.al. (1977) reported on the chemical analysis of nodules recovered from seven locations in the Bay of Quinte. Similarly, Fyfe, et.al. (1980) performed chemical analysis of ten ferromanganese nodules found near Glenora in the Bay of Quinte. They concluded that lake nodules are poor scavengers of minor elements when compared to marine equivalents.

In 1973, Fitchko (1974a, b) conducted a survey of surface and core samples of sediments from the mouths of waterways flowing into the Great Lakes. The sediments were analyzed for ten heavy metal (lead, silver, cadmium, copper, cobalt, chromium, nickel, zinc, manganese and mercury). Fitchko and Hutchinson (1975) concluded that the lower lakes had higher surficial levels of cadmium, mercury and chromium, and that differences in input were related to differences in

industrial release, natural geology and occurrence of heavy metal sinks.

Mudroch and Capobianco (1980) collected sediments from the Bay of Quinte south of Belleville and from locations upstream on the Moira River. The upstream locations were found to be elevated in arsenic, copper, cobalt and nickel as a result of mining and smelting activities. Only the Bay of Quinte station is included in the database for this report.

MOE (1982) conducted a sediment survey in the areas of Trenton, Belleville, Deseronto and Picton. These sediments were analyzed for nine heavy metals, numerous pesticides and total PCB. In 1985, sediment samples were collected as part of the In-Place Pollutant Program near Belleville and Trenton, and analyzed for 11 heavy metals, numerous pesticides and total PCB (Persaud, 1987). As well, PAH data for sediments collected near the mouth of the Moira River were available (Stride, 1987). The PCB results from the two recent surveys might be compared to earlier 1974 Bay of Quinte samples analyzed by Frank, et.al. (1980) for total PCB. However, only a mean PCB value for the Bay is presented by these authors.

Ontario Hydro (1977, 1978, 1980)) collected sediment samples in the Bay of Quinte at Long Reach in 1976, 1977 and 1977 in conjunction with an environmental impact assessment for laying of underwater cable. Sediments were analyzed for numerous heavy metals and pesticides.

During the snow melt and spring flow between 1974 and 1977, suspended solids were collected from 105 streams around the Great Lakes and analyzed for organochlorine and organophosphorus compounds (Frank, et.al., 1981), PCB, DDT and its metabolites occurred in all the streams sampled, including the Trent, Moira, Salmon and Napanee Rivers and Millhaven, Collins and Wilton Creeks.

Data available from these various studies are summarized in Table 4.1. Collectively, the studies contributing to the Bay of Quinte sediment database do not provide a comprehensive description of surficial sediment quality in the area. Very few specific locations have been sampled repeatedly in successive years, and with the exception of Frank, et.al. (1980) most of the sampling has been in the tributaries or river mouth areas.

4.2 Evaluation of Environmental Significance

The environmental significance of persistent toxic contaminants in Bay of Quinte sediments is assessed primarily in relation to existing provincial criteria for open water dredge spoil disposal (Persaud and Wilkins, 1975), and in relation to 'background' levels for contaminants in pre-industrial sediments strata from Lake Ontario harbour areas (Mudroch, et.al., 1986). These criteria are listed in Appendix Table A1.1.

Only surficial sediment data were utilized for comparison to dredge spoil disposal and background criteria. Ferromanganese nodules from Glenora and Big Bay, and deep sediment cores from several river mouths, were not considered appropriate for these comparisons. Surficial samples were available from the Trent River mouth and Bay of Quinte at Trenton (19973-74, 1982, 1985), the Moira River mouth and Bay of Quinte at Belleville (1973, 1977, 1982, 1985), the Napanee River mouth (1973), the Bay of Quinte proper in the general vicinity of Belleville, Trenton, Deseronto and Picton (MOE, 1982), and in the Long Reach area (Ontario Hydro, 1977, 1978, 1980). Some heavy metals exceeded dredge spoil disposal guidelines in all surficial sediment samples (Table 4.2). Zinc, iron and copper were

invariably included on the exceedence list. Cadmium had exceeded the guidelines in all locations except for the Bay of Quinte at Trenton. Chromium exceedences have occurred at all locations, although they were not reported in the 1973 samples in the Trent and Moira Rivers. Lead exceeded the guidelines in all locations except the Napanee River mouth. Nickel exceeded the guidelines in all locations except the Bay of Quinte at Trenton and the Trent River mouth. Mercury exceedences were reported at most locations in the Bay of Quinte and at the Trent River mouth.

Toxicity data for sediments are limited. However, the maximum cadmium and zinc concentrations in Table 4.2 frequently exceed the sediment concentrations reported to produce terata in developing rainbow trout embryos (1.0 ug L^{-1} cadmium, 100 ug L^{-1} zinc)(Birge, et.al., 1977).

PCBs have exceeded dredge spoil disposal guidelines at most locations in the Bay of Quinte. However, the average PCB concentration reported was below the guideline (Frank, et.al., 1980). Total PCB is the only organic parameter for which dredge spoil disposal guidelines exist.

Background sediment criteria may be more appropriate for

assessment of environmental significance of persistent toxic contaminants. With the single exception of lead, pre-industrial background levels in depositional areas of Lake Ontario are higher than the somewhat arbitrary dredge spoil disposal guidelines. Lead exceeded background at all locations. Zinc exceeded background in all samples except the 1979 samples at Long Reach. Cadmium exceeded background in some samples on the Trent and Moira Rivers, and in the Belleville vicinity of the Bay of Quinte. Nickel exceeded background only in the Bay of Quinte near Picton, south of Belleville and at Long Reach (1977 samples), while mercury exceeded background levels at Bay of Quinte at Belleville.

PCBs exceeded background sediment concentrations in many of the samples in which PCB levels also exceeded dredge spoil disposal guidelines. The highest reported concentration in 1972 was 260 ng L^{-1}, while in 1982, the maximum PCB level reported was 320 ng L^{-1}.

While it is clear the sediments in and near the Bay of Quinte tributaries are contaminated with heavy metals and PCB, the extent and significance of this contamination for the Bay of Quinte as a whole is difficult to assess without additional sampling throughout the Bay. A more extensive program if

surficial sediment sampling is required.

4.3 Trend-in-Time Analysis

Available sediment data do not provide the continuity over time that is needed for analysis of temporal trends. Trend-in-time comparison of the Ontario Hydro data would not be valid as the 1979 samples were collected in the nearshore areas only. The generally lower metal concentrations in the 1979 samples reflect the lower organic content (based on % loss on ignition) and, therefore, sorption capacity of the sediments.

PCB was sampled at Bay of Quinte locations in 1972, 1982 and 1985. If these data are compared, mean PCB concentrations are higher for the more recent samples. However, the 1972 survey was more extensive, covering the entire Bay; whereas, the 1982 and 1985 surveys were located in the Bay near contaminant sources (ie. at Belleville and Trenton).

4.4 Ongoing Studies

The MOE In-Place Pollutants Program, initiated in 1983 to determine the extent and impact of sediment contamination by

persistent toxic substances, continues to generate sediment quality data pertinent to evaluation of the Bay of Quinte ecosystem. Fixed sampling stations, including a number in the Bay of Quinte, have been established in areas of concern around the Great Lakes. The most recent data (1985) from a single Bay of Quinte stations are discussed in Section 5.4 with respect to bioaccumulation by benthic organisms.

5.0 PERSISTENT TOXIC CONTAMINANTS IN BIOTA

5.1 Extent of the Database

Data provided by Johnson (1987) were collected from 1968 to 1982 as part of the Sport Fish Testing Program of MOE and the Ontario Ministry of Natural Resources (MNR). This program was established to analyze fish samples for various toxic contaminants, and to support issuance of fish consumption advisories on an annual basis (MOE, 1987).

In 1975, the Nearshore Juvenile Fish Contaminants Surveillance Program was initiated by the MOE to identify specific areas of concern for organochlorine contaminants in the Great Lakes. Surveillance data included in this report were collected by Suns (1987) and Suns, et.al. (1978, 1985) between 1975 and 1986. The reports published by these authors describe temporal trends for organochlorine and mercury residues in nearshore juvenile fish (eg. spottail shiners, golden shiners and yellow perch), and recent spatial distributions of contaminants in nearshore waters of the Great Lakes. Reports following the 1978 study have indicated that young-or-tue-year spottail shiners are effective integrators of organochlorine compounds and, thus, could be used for site-specific contaminant investigations (Suns and

Rees, 1978; Suns, et.al., 1981).

Fox and Joshi (1984) determined pentachlorophenol in several fish and invertebrate samples collected from the Bay of Quinte in 1978. Tetrachlorophenol was not determined in fish in this instance due to lipid interference.

Fish collected by Shum (1987) from 1972-86 were analyzed for PCB, DDT and mercury concentrations as part of a federal Fisheries and Oceans Canada (DFO) program. Shum concluded that contaminant levels in some species have been reduced since the mid-1970's. In addition, Whittle (1987) provided DFO data for walleye collected in the Bay of Quinte in July 1982. These data, collected as part of a Great Lakes Surveillance study, included concentrations of a variety of pesticides, PCB and heavy metals.

The data are summarized in Table 5.1. Collectively, the database contains relatively few samples of the same species at any particular location in the Bay of Quinte. However, many samples are simply identified as 'Bay of Quinte samples'. If these data are considered comparable, the database contains meaningful temporal series for a number of species including American eel, brown bullhead, carp, channel

catfish, northern pike, white perch and yellow perch.

5.2 Evaluation of Environmental Significance

Data on persistent toxic contaminants in Bay of Quinte biota are limited mainly to fish samples. Environmental significance of fish consumption is assessed with respect to guidelines for fish consumption (Table A1.1). Chemical parameters and fish species exceeding fish consumption guidelines are listed as concentrations means, maxima and percent exceedence in Table 5.2.

Chemical parameters which have exceeded fish consumption guidelines in Bay of Quinte fish include DDT (smallmouth bass, 1968), mercury (American eel, 1975; channel catfish, 1975; smallmouth bass, 1975, 1976, 1981; northern pike, 1973, 1975; largemouth bass, 1975, 1981; walleye, 1971, 1975, 1981; sheepshead, 1976, 1984), mirex (American eel, 1982; rainbow smelt, 1976, 1977; white perch, 1980; walleye, 1891), and PCB (American eel, 1973, 1975, 1976, 1980, 1982, 1983, 1985, 1986; carp, 1874, 1977, 1979; channel catfish, 1975, 1976, 1979, 1980, 1983, 1984, 1986; northern pike, 1975; rainbow smelt, 1976; sheepshead, 1975, 1976; walleye, 1976, 1979, 1981, 1982; white perch, 1980,

1984).

Based on mean contaminant concentrations, chemical parameters which have exceeded fish consumption guidelines in Bay of Quinte fish include DDT (smallmouth bass, 1968), mercury (northern pike, 1973; smallmouth bass, 1975; sheepshead, 1976, 1984; walleye, 1971), mirex (American eel, 1982; rainbow smelt, 1976), and PCB (American eel, 1973, 1975, 1976, 1980, 1982, 1983, 1985, 1986; carp, 1974, 1979; channel catfish, 1975, 1976, 1979, 1983, 1984, 1986; sheepshead, 1976; walleye, 1976, 1979, 1982; white perch, 1984).

Exceedence statistics can be broken down by specific locations in the Bay of Quinte. However, this leaves very little temporal continuity in the small data set remaining at each location. Many samples are not assigned to specific locations in the database other than 'Bay of Quinte' (Location 5). In most cases, the reports do not specify location, or apparently the authors considered the data pertinent to interpretation of integrative data for highly mobile organisms. It is likely that individuals of most fish species reported in the database range widely throughout the Bay of Quinte and, in some species (eg. American eel) Lake

Ontario.

The statistics in Table 5.2 are computed for the Bay of Quinte as a whole without regard to specific locations within the Bay. The highest concentrations of mercury seem to have been associated with walleye, high mirex concentrations with American eel and rainbow smelt, and those of PCB with American eel and channel catfish.

Fox and Joshi (1984) have detected pentachlorophenol in brown bullhead (260 ng g^{-1}) and yellow perch (155 ng g^{-1}) from the Bay of Quinte, and in leeches (85 ng g^{-1}) and chironomids (1 ng g^{-1}), Tetrachlorophenol was also found in leeches 40 ng g^{-1}).

The Niagara River Toxics Committee (1984) reported that six out of six yellow perch and five out of six white perch collected form the Bay of Quinte had dioxin levels below the 0.000010 ug g^{-1} detection limit. One white perch had a dioxin concentration on 0.000016 ug g^{-1}.

5.3 Trend-in-Time Analysis

Many species and locations in the database have not been sampled with sufficiently regularity in the Bay of Quinte to permit examination of long-term temporal trends. Sufficient data do exist for American eel, brown bullhead, carp, channel catfish, northern pike, white perch and yellow perch at Location 5 ('Bay of Quinte'). The chemical parameters which have exceeded fish consumption guidelines in Bay of Quinte fish were examined in these species at Location 5 for evidence of consistent temporal trends.

When trends were suggested, they were invariably toward reduction of persistent toxic contaminant concentrations. In other cases, there were no significant changes. Figures 5.1 and 5.2 suggest a general decline in mercury and DDT concentrations, respectively, in fish species with mean levels below the provincial fish consumption guidelines. Figure 5.3 illustrates a similar decline in PCB concentration particularly for American eel and channel catfish, although mean levels in these two species were still above the provincial fish consumption guidelines.

The temporal trends illustrated in Figures 5.1 through 5.3 are consistent with trends reported for Great Lakes sport

fish over the past decade (MOE, 1987). For example, reductions in mercury (walleye), PCB (lake trout), and mirex (lake trout) have been reported throughout Lake Ontario.

5.4 Genotoxic Manifestations

Genetic responses of aquatic organisms t pollution stresses have received little attention. A number of morphological abnormalities, especially tumors in fish and congential anomalies in birds, have been documented in some Great Lakes biota. Some of these occurrences may be genetic responses; others may result from non-genetic, developmental problems. The causal agents and mechanisms remain largely unknown.

Mutagenic toxic substances are usually of far greater direct hazard and significance to man than to other biotic populations (Woodwell, 1970). A slightly enhanced rate of mutations due to mutagenic chemicals is considered significant to man because of the value placed on the individual by society. In contrast, a slightly increased mutation rate is inconsequential to many animal populations since most genetic defects are eliminated through natural selection.

A significant number of compounds have been identified as having mutagenic, carcinogenic or teratogenic activity (Huff, 1982; Soderman, 1982). Notwithstanding natural repair of genetic damage, mutations tend to accumulate over the lifetime of a cell. Many heritable mutations result from faulty repair of more serious, non-heritable genetic change. Hertiable mutations can be passed on to the descendants of a replicating somatic cell, or through the germ cells, to the progeny of a reproducing organism. Since mutations can accumulate in this fashion, an organism's mutational load tends to be proportional to mutagen concentration and exposure over its lifetime.

Both mutagenesis and carcinogenesis have been associated with chromosomal damage. Therefore, it has been hypothesized that the first essential event in malignant transformation is a mutational event. This theory, known as the somatic mutation hypothesis, predicts that mutagens are carcinogens. However, recent studies have shown a significant number of mutagens that are not carcinogens and a few nonmutagens that are carcinogens. It is generally considered that there is no threshold exposure for the initiation of mutagenic or carcinogenic manifestations.

Teratogenic agents act during embryonic development to produce physical or functional defects in the fetus or offspring. The defects may result from damage to the genetic material controlling development and many mutagens have such teratogenic effects. However, embryonic development is also subject to non-genetic perturbation, and many strong teratogens do not produce mutations. Response thresholds, or minimum effective dosages, have been demonstrated for some teratogens.

An increasing number of studies have been undertaken in the past ten years to assess the frequency and extent of mutagenic, carcinogenic and teratogenic events among aquatic populations, including those of the Great Lakes. A number of these studies pertain specifically to the Bay of Quinte.

Dutka and Switzer-House (1978) have tested water samples from the Bay of Quinte for mutagenic activity, employing the Ames test with metabolic activation of the sample by rat liver microsomes. The sample was taken near the mouth of the Bay at Amherst Island. A significant increase in Salmonella reversion frequency was obtained in one of three bacterial strains tested. Reversion frequency in the Bay of Quinte was 1.38 times the control reversion frequency.

The Great Lakes Fisheries Research Branch of DFO has initiated a white sucker tumor monitoring program to quantify carcinogenic potential in a number of areas of concern around the Great Lakes. Data from 1981 through 1983 (IJC, 1983) indicate a relatively low lip papilloma frequency of 6% in samples of fish greater than 40 cm for the Bay of Quinte near Amherst Island. This compares to a frequency of 39% in Hamilton Harbour samples and 0% in some Georgian Bay populations.

Warwick (1980) recovered a number of deformed chironomic larvae - twisted, gnarled, asymmetrical teeth in the mentum and mandibles, as well as, a thickened cuticle of the body and head capsule walls - from core sediments collected in the Bay of Quinte. The percentage of deformed specimens of Chironomus and Procladius clearly increased in the most recent sediments. Based on sediment core dating, the incidence of deformities increased from 0.09% in the pre-European sediments to 1.06% at a depth of 4.5 cm (1951) and 1.99% in the 1972 chironomid population. While a teratogenic response to anthropogenic agents is suggested, it has not been determined whether the response has a genetic basis, and specific causal agents in the sediments have not been identified.

5.5 Ongoing Studies

The MOE Nearshore Juvenile Fish Contaminants Surveillance Program, initiated in 1975, and the MOE/MNR Sport Fish Testing Program, initiated in 1969, both may be expected to continue providing fish residue data pertinent to evaluation of the Bay of Quinte ecosystem. The DFO fish residue surveillance studies are also continuing around the Great Lakes.

Fish tumor studies involving Bay of Quinte samples have recently been initiated jointly by MNR and MOE. These data will be available in the fall of 1987.

Some preliminary data on persistent toxic contaminants in benthic invertebrate organisms from the Bay of Quinte are available from the MOE In-Place Pollutants Program (Persaud, 1987). This work is currently being reviewed as part of a program to develop sediment quality objectives. While guidelines for acceptable concentrations of toxic contaminants in benthic organisms do not currently exist, biological responses of the resident benthic community may eventually provide the most meaningful indication of environmental significance of persistent toxic substances in particular areas of concern.

In-Place Pollutants Program data from the Bay of Quinte currently are limited to three stations at which total organism density, Shannon-Weiner diversity, and metals, pesticides and PCB in sediments and biota were measured in 1985. Biota include Amphipoda, Isopoda and Chironomidae. Concentrations of compounds detected in these organisms are listed in Table 5.3.

6.0 POTENTIAL SOURCES

Probable sources of contamination can be identified from their proximity to sampling locations where water quality and sediment objectives have been exceeded, and from actual effluent analyses. These water quality and sediment data are summarized in Sections 3.0 and 4.0.

The Trent Valley Paperboard mills and Domtar Wood Preserving and Packaging plants on the Trent River have been associated with phenol and/or PCP exceedences of water quality objectives. Thus, it is likely that these facilities are key point sources. PCPs also were found in the Trent STP effluent. PCB exceedences of dredged spoil disposal guidelines in the Trent River mouth sediments also may be sourced at these facilities since it is this area where the sediment objective exceedences occurred.

The Bakelite Thermosets plant on the Bay of Quinte at Belleville has been associated with both phenolic and iron exceedences. Both these parameters also exceed water quality objectives in the Belleville STP effluent. As well, PCB dredged spoil guidelines were exceeded at the mouth of the Moira River. The Bakelite plant is a potential source,

although more conclusive data is needed in this regard.

Phenol and PCP have occurred in Picton Marsh Creek. Potential sources in this area may include the Picton landfill and the Water Pollution Control Plant.

Phenol exceedences have occurred on most Bay of Quinte tributaries, with the exception of Millhaven Creek. On the Napanee River, the Strathcona Papers plant is a potential source.

The municipal STPs all have exceeded water quality objectives for various heavy metals. Thus, the STPs should be considered potential heavy metal sources.

In addition, the Trenton Iron Works on the Trent River is a potential source of iron. Deloro Smelting and Refining is a recognized source of arsenic through groundwater contamination to the Moira River (a clay cap to prevent surface water from reaching the groundwater is proposed with construction to start in 1988). Other mining sites which may impact the Bay include Marmora (iron), Eldorado (gold, copper), Sulphide, Tweed and Madoc (lead and iron)(Sly in Minns, et.al., 1986).

Three coal gasification sites occur in the Bay of Quinte region, one each at Belleville, Deseronto and Napanee. These sites are potential sources of PAHs. In this regard, an oil slick was observed on the Moira River in 1981, and PAHs were detected in the soils on 1981 and sediments in 1983 at the Belleville site. The Belleville plant is also very near the Bay of Quinte and the Moira River. The Deseronto plant is small, but residential construction on-site may lead to possible health concerns. The Napanee plant is also small with some residential site use at present with no problems reported.

Numerous landfill sites occur in the Bay of Quinte region. Some of these sites could be potential sources of contaminant inputs to the Bay. All the sites are listed by type and status in Table 6.1.

Other potential sources of contaminant input to the region include (1) atmospheric input, (2) introductions via the food chain (eg., fish from Lake Ontario migrating into the Bay), and (3) urban and rural land runoff.

7.0 DATA DEFICIENCIES

The major deficiency in the database is the lack of analytical data for sampling locations throughout the Bay of Quinte proper. Most of the sampling and analytical effort has been concentrated on tributaries and known point sources. While these data are important, they do not permit evaluation of the extent of impact from persistent toxic contaminants on the Bay of Quinte as a whole.

Lack of temporal continuity in the database is a problem, particularly for the sediment data which consists of few surficial samples, and only one location (on the Trent River) where sampling has been repeated in more than one year. The MOE tributary monitoring database provides a measure of continuity for assessment of water quality trends.

Lack of biological data for benthic organisms resident in the Bay of Quinte (Density, diversity, tissue concentration) limits the assessment of ecological impacts to consideration of fish species, many of which are highly mobile and, thus, may be poor site-specific indicators of persistent toxic contaminants of environmental significance. Data from the In-Place Pollutants Program may meet this need in the future

and permit a more comprehensive evaluation of environmental concerns.

8.0 SPECIFIC CONCERNS

Based on current and past exceedences of water quality objectives, dredge spoil disposal guidelines and fish consumption guidelines, specific concerns pertaining to persistent toxic contaminants by the Bay of Quinte include:

- Phenolics in the Bay of Quinte at Belleville, the Trent River and Picton Marsh Creek, and the water of the Bay near the mouth of these tributaries (the PCB objective for protection of aquatic life is currently exceeded in the Trent River;

- Iron in water of the Bay of Quinte at Belleville and the Trent River, as well as, a number of heavy metals in Picton Marsh Creek and in STP effluents at Belleville, Napanee and Deseronto (particularly copper and zinc);

- Based on analysis of the tributary monitoring database, water quality objectives are currently being exceeded for iron, nickel, zinc, copper and lead at one or more of the tributaries flowing into the Bay;

- Heavy metals in sediments of the Bay of Quinte at Belleville, the Trent and Napanee Rivers, and in the Bay near these tributary mouths;

- PCBs in sediments of the Bay of Quinte at Belleville, the Trent River and the Bay near the mouth of the Trent River; and,

- Mercury, PCB, mirex and DDT in some species of fish have been detected in some years.

Although specific objectives have yet to be developed, there is a concern regarding effects of persistent toxic contaminants, particularly heavy metals and PCB, on the resident benthic community of the Bay of Quinte.

9.0 CONCLUSIONS

1. Available data on persistent toxic contaminants in the Bay of Quinte ecosystem pertain primarily to tributaries and potential point sources. Data reflecting impact on the Bay as a whole are sparse and inconclusive.

2. Based on exceedence of water quality, dredge spoil disposal and fish consumption guidelines, the following have been identified in some years as specific concerns:

   (a) phenol, pentachlorophenol and some heavy metals in water;

   (b) some heavy metals and PCB in sediments; and,

   (c) PCB, mirex, mercury and DDT in some fish species.

3. Water quality trends reduction of phenols and heavy metals in tributaries and mercury, PCB and DDT in some species of fish are evident.

4. Sediment data are insufficient for the assessment of long-term trends.

5. Potential sources of phenolics include:

   (a) Trent Valley Paperboard Mills and Domtar Wood Preserving and Packaging plants on the Trent River;

   (b) Bakelite Thermosets Limited on the Bay of Quinte at Belleville; and,

   (c) Picton, Belleville and Trenton Water Pollution Control Plants.

6. The Domtar plants and the Bakelite plant are also associated with iron inputs and, possibly, PCB in sediments.

7. STPs at Trenton, Belleville, Deseronto, Napanee and Picton appear to act as heavy metal sources.

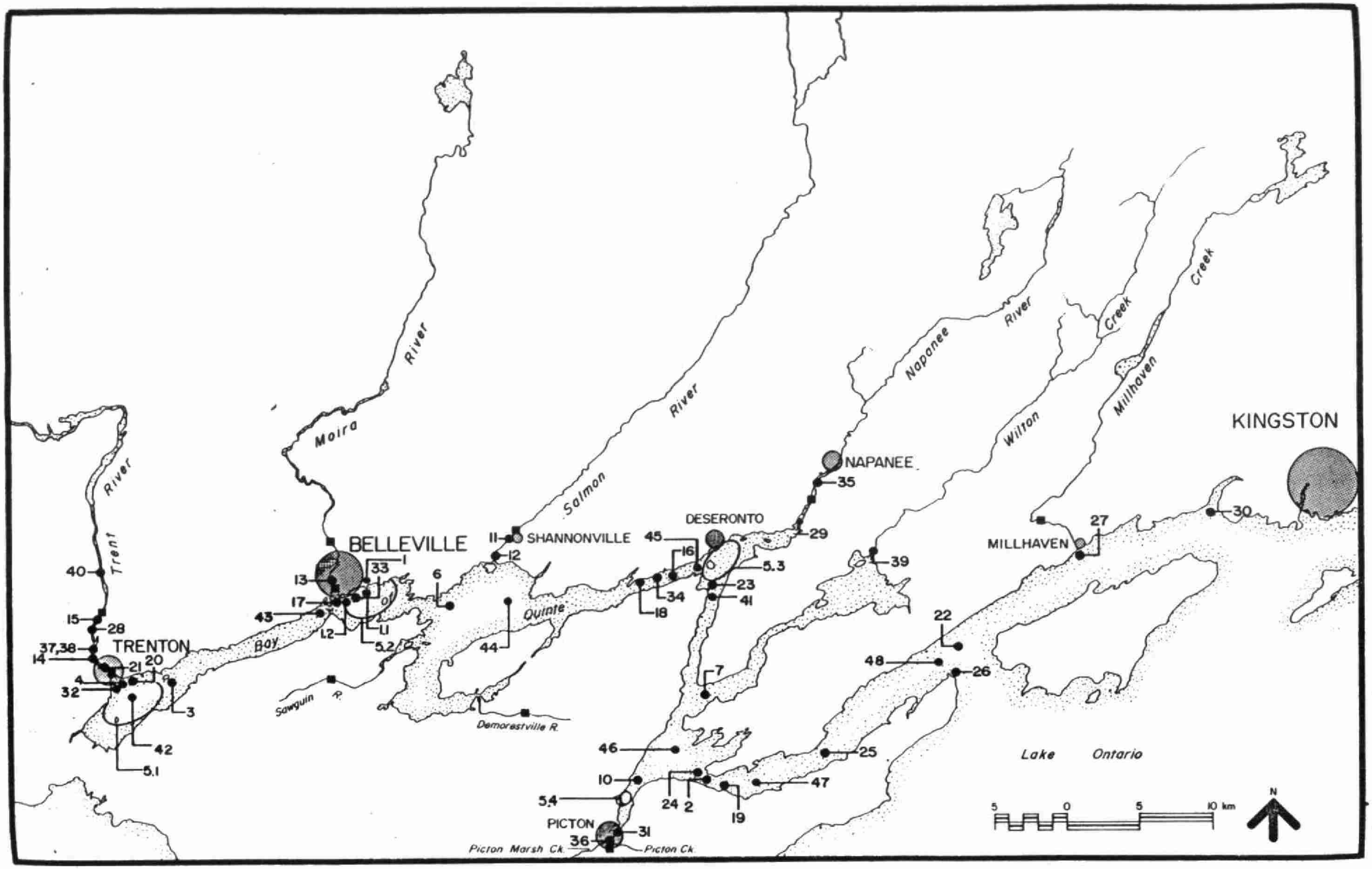

FIGURE 2.1 Bay of Quinte Study Area and Sampling Locations

■ OMOE TRIBUTARY MONITORING STATIONS
● OTHER MONITORING STATIONS

TABLE 2.1: SAMPLING LOCATIONS, DATES AND ENVIRONMENTAL MEDIA

Location[1]	Code	Year of Sampling (19xx)		
		Water (see Table 3.1)	Sediment (see Table 4.1)	Biota (see Table 5.1)
Bakelite Process Water, Site Drainage	1	80, 81		
Bay of Quinte at Belleville	1.1	81		
Bay of Quinte at Belleville	1.2		85	75, 76, 77
Bay of Quinte at Glenora	2		70+	75
Baker Island	3			76
Bay of Quinte at Trenton	4		85	76, 79
Bay of Quinte (location unspecified)	5		72, 72+	68, 69, 71-86
Bay of Quinte (various; see Figure 2.1)	5.1-5.4		82	
Bay of Quinte at Big Bay	6		70, 72+	
Bay of Quinte at Hay Bay	7			76, 80, 81
Bay of Quinte at Picton Bay	10			77
Bay of Quinte at Salmon River	11		74**	77
Bay of Quinte at Salmon R. Estuary	12			77
Bay of Quinte at Moira River	13		73, 74**, 82	78
Trent River at Trenton	14	78		81
Trent River Below No. 1 Dam	15	81, 83, 85,86		81
Bay of Quinte - Telegraph Narrows	16		72+	
Bay of Quinte South of Belleville	17	77, 78	77	
Bay of Quinte - West of Deseronto	18			81
Glenora Upper Gap	19			82
Trenton Bay at Trenton	20			79, 81, 82, 85, 86
Trenton Bay at Trent River	21	78		
Bay of Quinte - Brothers Island	22	78, 83	72+	
Bay of Quinte - Green Point	23		72+	
Bay of Quinte - Glenora Ferry	24		72+	
Bay of Quinte - Adolphus Reach	25		72+	
Bay of Quinte - Indian Point	26		72+	
Millhaven Creek	27		74**	
Trent River	28		74**	
Napanee River	29		74**	
Collins Creek	30		74**	
Marsh Creek at Picton	31	82		
Trenton STP	32	82*		
Belleville STP	33	82*		
Deseronto STP	34	82*		
Napanee STP	35	82*		
Picton STP	36	82*		
Domtar Wood Preserving	37	82*		
Domtar Packaging	38	82*		
Wilton Creek	39	82	74**	
Trent Valley Paperboard	40	77		
Bay of Quinte - Long Reach	41	76, 82	76, 77, 79, 82	
Bay of Quinte - South of Trenton	42	78		
Bay of Quinte - Southwest of Belleville	43	78		
Bay of Quinte - South of Shannonville	44	78		
Bay of Quinte - South of Deseronto	45	78		
Bay of Quinte - West of Mallory Bay	46	78		
Bay of Quinte - South of Pull Point	47	78		
Bay of Quinte - Northwest of Indian Point	48	78		

1 Location codes refer to map Figure 2.1.
* effluent
** suspended solids
+ ferromanganese nodules

TABLE 3.1: WATER QUALITY DATA SOURCES

Location	Code[1]	Year	No. of Stations	Parameters	Reference
Trent River - upstream and downstream of Domtar Wood Preserving and Domtar Packaging at Trenton	15	1981	15	Phenolics, pentachlorophenol, Fe	Dillenbeck (1981a)
Trent River - upstream and downstream of Domtar Wood Preserving and Domtar Packaging at Trenton	15	1983	15	Phenolics, pentachlorophenol, Fe	Dillenbeck (1983)
Trent River - upstream and downstream of Trent Valley Paperboard Mills at Glen Miller	40	1977	20	Phenolics	Dillenbeck (1977)
Marsh Creek at Picton	31	1982	11	Phenolics, Al, As, Cd, Co, Cr, Cu, Fe, Hg, Mo, Ni, Po, Se, Zn	Metcalfe (1982)
Bay of Quinte - near Bakelite Thermosets Ltd. and Belleville STP at Belleville	1, 1.1	1980, 1981	17	Phenolics, Fe	Dillenbeck (1981b)
Wilton Creek	39	1982	1	50 organics; 10 metals	MOE (1984b)
Picton Marsh Creek	-	1973-87	1	28 organics; 12 metals*	MOE (1973-87)
Moira River (km 1.127, 6.276)	-	1973-87	2	28 organics; 12 metals*	MOE (1973-87)
Napanee River (km 5.633)	-	1973-87	1	28 organics; 12 metals*	MOE (1973-87)
Picton Creek (km 1.287)	-	1973-87	1	28 organics; 12 metals*	MOE (1973-87)
Sawguin River (km 8.851)	-	1973-87	1	28 organics; 12 metals*	MOE (1973-87)
Trent River (km 0.805, 3.862)	-	1973-87	2	28 organics; 12 metals*	MOE (1973-87)
Salmon River (km 2.897)	-	1973-87	1	28 organics; 12 metals*	MOE (1973-87)
Millhaven Creek (km 6.437)	-	1973-87	1	28 organics; 12 metals*	MOE (1973-87)
Trenton STP Effluent	32	1982	1	50 organics; 10 metals	MOE (1984b)
Belleville STP Effluent	33	1982	1	57 organics; 9 metals	MOE (1984b)
Deseronto STP Effluent	34	1982	1	50 organics; 10 metals	MOE (1984b)
Napanee STP Effluent	35	1982	1	48 organics; 10 metals	MOE (1984b)
Picton STP Effluent	36	1982	1	49 organics; 10 metals	MOE (1984b)
Domtar Wood Preserving Effluent	37	1982	1	41 organics	MOE (1984b)
Domtar Packaging	38	1982, 1986	1	19 organics, phenolics	MOE (1984b), Naish et al. (1986)
Bay of Quinte - Long Reach	41	1976, 1982	4	As, Hg, Pb	Ontario Hydro (1977, 1983)
Trent River at Trenton	15	1985	10	Hg	Naish et al. (1986)
Trent River at Trenton	15	1986	10	Phenolics, pentachlorophenol, tetrachlorophenol	Naish et al. (1986), Shariff et al. (1987)
Trent River at Trenton	14	1978	1	Pentachlorophenol, tetrachlorophenol	Fox and Joshi (1984)
Bay of Quinte South of Belleville	17	1978	1	Pentachlorophenol, tetrachlorophenol	Fox and Joshi (1984)
Bay of Quinte South of Belleville	17	1977	1	As, Cr, Co, Cu, Pb, Hg, Zn	Mudroch and Capobianco (1980)
Trenton Bay at Trent River	21	1978	1	Pentachlorophenol, tetrachlorophenol	Fox and Joshi (1984)
Bay of Quinte - Brothers Island	22	1978	1	Pentachlorophenol, tetrachlorophenol	Fox and Joshi (1984)
Bay of Quinte - Brothers Island	22	1983	1	Chlorobenzenes, organochlorine pesticides, PCB	Biberhofer and Stevens (1987)
Bay of Quinte - various	42-48	1978	7	Pentachlorophenol, tetrachlorophenol	Fox and Joshi (1984)

[1] Location codes refer to map Figure 2.1, except Code 5 (unspecified location). Dash indicates MOE tributary monitoring stations.

* All parameters are not represented in all years. Organics are included only at a few stations in some years.

TABLE 3.2: PERCENT EXCEEDENCE OF WATER QUALITY OBJECTIVES FOR DRINKING WATER AND PROTECTION OF AQUATIC LIFE BY LOCATION IN THE BAY OF QUINTE (excluding MOE tributary monitoring data)

Chemical Parameter[1]	Location	Code[2]	Year	Concentration[3] (mg/L) Max	Mean	S.D.	N	% Exceedence[4] Drinking Water	Aquatic Life
Phenol	Bay of Quinte at Belleville	1.1	1981	0.500	0.0054	0.0437	130	8	11
Iron		1.1	1981	1.000	0.1946	0.1776	28	7	7
Pentachlorophenol	Trent River at Trenton	14	1978	0.00575	0.00013	0.00024	5	0.0	20
Tetrachlorophenol		14	1978	0.000086	0.000027	0.000035	5	0.0	0.0
Phenol	Trent River Below No. 1 Dam	15	1981	0.155	0.011	0.029	149	40	51
Iron		15	1981	10.00	0.591	1.646	61	20	20
Pentachlorophenol		15	1981	1.600	0.125	0.387	28	21	68
Phenol		15	1983	0.430	0.0195	0.057	67	61	81
Pentachlorophenol		15	1983	0.0076	0.00095	0.0023	15	0.0	13
Iron		15	1983	8.00	0.493	1.308	75	15	15
Phenol		15	1986	0.032	0.003	0.008	15	20	20
Pentachlorophenol		15	1986	0.00024	0.000050	0.000075	9	0.0	0.0
Mercury		15	1986	0.00024	0.000139	0.0000708	10	0.0	20
Tetrachlorophenol		15	1986	0.00003	0.000014	0.000010	9	0.0	0.0
Chromium	Bay of Quinte - South of Belleville	17	1977	0.001	0.001	0.0	1	0.0	0.0
Copper		17	1977	0.001	0.001	0.0	1	0.0	0.0
Mercury		17	1977	0.00002	0.00002	0.0	1	0.0	0.0
Arsenic		17	1977	0.015	0.015	0.0	1	0.0	0.0
Nickel		17	1977	0.001	0.001	0.0	1	0.0	0.0
Lead		17	1977	0.001	0.001	0.0	1	0.0	0.0
Zinc		17	1977	0.003	0.003	0.0	1	0.0	0.0
Pentachlorophenol		17	1978	0.00004	0.000016	0.000013	5	0.0	0.0
Tetrachlorophenol		17	1978	0.000015	0.000009	0.000004	5	0.0	0.0
Pentachlorophenol	Trenton Bay at Trent River	21	1978	0.0056	0.0019	0.0032	3	0.0	33
Tetrachlorophenol		21	1978	0.001	0.0003	0.0005	3	33	0.0
Pentachlorophenol	Bay of Quinte - Brother's Island	22	1978	0.000029	0.00001	0.00001	5	0.0	0.0
Tetrachlorophenol		22	1978	0.00003	0.00001	0.000009	5	0.0	0.0
Mercury	Marsh Creek at Picton	31	1982	0.04	0.004	0.012	10	10	10
Phenol		31	1982	0.0018	0.001	0.0005	17	0.0	53
Pentachlorophenol		31	1982	0.0012	0.0008	0.0003	3	0.0	67
Iron		31	1982	3.8	0.815	1.047	22	55	55
Cadmium		31	1982	0.0002	0.00018	0.00005	22	0.0	0.0
Chromium		31	1982	0.009	0.0019	0.0018	22	0.0	0.0
Copper		31	1982	8.1	0.378	1.72	22	5	77
Arsenic		31	1982	0.001	0.001	0.0	22	0.0	0.0
Lead		31	1982	0.07	0.0086	0.014	22	5	9
Zinc		31	1982	0.067	0.012	0.016	22	5	9
Nickel		31	1982	0.001	0.001	0.0	22	0.0	0.0
γ-BHC	Trenton STP Effluent	32	1982	0.00001	0.00001	0.0	1	0.0	100
HCB		32	1982	0.00001	0.000008	0.000002	2	50	0.0
Iron		32	1982	0.6	0.6	0.0	1	100	100
Pentachlorophenol		32	1982	0.00118	0.00099	0.00026	2	0.0	100
Cadmium		32	1982	0.0002	0.0002	0.0	1	0.0	0.0
Chromium		32	1982	0.003	0.003	0.0	1	0.0	0.0
Copper		32	1982	0.023	0.023	0.0	1	0.0	100
Mercury		32	1982	0.00005	0.00004	0.00001	2	0.0	0.0
Lead		32	1982	0.005	0.004	0.0014	2	0.0	0.0
Zinc		32	1982	0.023	0.023	0.0	1	0.0	0.0
Nickel		32	1982	0.013	0.013	0.0	1	100	0.0
Tetrachlorophenol		32	1982	0.0023	0.0012	0.0015	2	50	0.0
Phenol	Belleville STP Effluent	33	1982	0.004	0.004	0.0	1	100	100
Nickel		33	1982	0.028	0.0185	0.0134	2	100	50
Iron		33	1982	0.46	0.33	0.183	2	50	50
Cadmium		33	1982	0.0004	0.0003	0.0001	2	0.0	50
Chromium		33	1982	0.022	0.02	0.002	2	0.0	0.0
Mercury		33	1982	0.00008	0.00006	0.00002	2	0.0	0.0
Arsenic		33	1982	0.002	0.001	0.0007	2	0.0	0.0
Copper		33	1982	0.039	0.028	0.015	2	0.0	100
Lead		33	1982	0.004	0.0035	0.0007	2	0.0	0.0
γ-BHC		33	1982	0.000003	0.000002	0.000001	2	0.0	0.0
Copper	Deseronto STP Effluent	34	1982	0.009	0.009	0.0	1	0.0	100
Pentachlorophenol		34	1982	0.0001	0.0001	0.0	1	0.0	0.0
Iron		34	1982	0.046	0.046	0.0	1	0.0	0.0

TABLE 3.2: PERCENT EXCEEDENCE OF WATER QUALITY OBJECTIVES FOR DRINKING WATER AND PROTECTION OF AQUATIC LIFE BY LOCATION IN THE BAY OF QUINTE (excluding MOE tributary monitoring data)

Chemical Parameter[1]	Location	Code[2]	Year	Concentration[3] (mg/L) Max	Mean	S.D.	N	% Exceedence[4] Drinking Water	Aquatic Life
Pentachlorophenol	Napanee STP Effluent	35	1982	0.0001	0.0001	0.0	2	0.0	0.0
Copper		35	1982	0.034	0.024	0.014	2	0.0	100
Lead		35	1982	0.027	0.015	0.016	2	0.0	50
Zinc		35	1982	0.065	0.040	0.034	2	0.0	50
Iron		35	1982	3.9	3.9	0.0	1	100	100
Cadmium		35	1982	0.0004	0.0004	0.0	2	0.0	100
Chromium		35	1982	0.007	0.005	0.002	2	0.0	0.0
Nickel		35	1982	0.005	0.0035	0.0021	2	100	0.0
Mercury		35	1982	0.00002	0.000015	0.000007	2	0.0	0.0
Arsenic		35	1982	0.001	0.001	0.0	1	0.0	0.0
Pentachlorophenol	Picton STP Effluent	36	1982	0.0004	0.0002	0.0002	2	0.0	0.0
Iron		36	1982	0.24	0.24	0.0	1	0.0	0.0
Chromium		36	1982	0.013	0.011	0.0028	2	0.0	0.0
Nickel		36	1982	0.006	0.005	0.0014	2	100	0.0
Mercury		36	1982	0.00016	0.0001	0.00007	2	0.0	0.0
Copper		36	1982	0.02	0.016	0.004	2	0.0	100
Zinc		36	1982	0.031	0.023	0.011	2	0.0	50
Tetrachlorophenol		36	1982	0.0006	0.0003	0.0003	2	50	0.0
Phenol	Domtar Wood Effluent	37	1982	0.03	0.03	0.0	1	100	100
HCB		37	1982	0.000005	0.000003	0.000002	2	0.0	0.0
Phenol	Domtar Packaging Effluent	38	1982	4.8	4.8	0.0	1	100	100
Nickel	Wilton Creek	39	1982	0.002	0.002	0.0	1	100	0.0
Iron		39	1982	0.17	0.17	0.0	1	0.0	0.0
Chromium		39	1982	0.002	0.002	0.0	1	0.0	0.0
Copper		39	1982	0.005	0.005	0.0	1	0.0	0.0
Mercury		39	1982	0.00005	0.00005	0.0	1	0.0	0.0
Lead		39	1982	0.003	0.003	0.0	1	0.0	0.0
Phenol	Trent Valley Paperboard	40	1977	0.005	0.0016	0.001	40	15	35
Iron	Bay of Quinte - Long Reach	41	1976	0.18	0.1007	0.055	4	0.0	0.0
Copper		41	1976	0.038	0.029	0.0062	4	0.0	100
Nickel		41	1976	0.1	0.063	0.046	4	25	0.0
Mercury		41	1982	0.00036	0.00009	0.0001	8	0.0	12.5
Arsenic		41	1982	0.002	0.0017	0.0002	8	0.0	0.0
Lead		41	1982	0.020	0.011	0.0035	8	0.0	0.0
Zinc		41	1982	0.026	0.0131	0.0059	8	0.0	0.0
Pentachlorophenol	Bay of Quinte - South of	42	1978	0.0009	0.0002	0.0003	5	0.0	20
Tetrachlorophenol	Trenton	42	1978	0.0001	0.00003	0.00003	5	0.0	0.0
Pentachlorophenol	Bay of Quinte - Southwest	43	1978	0.00009	0.00003	0.00004	5	0.0	0.0
Tetrachlorophenol	of Belleville	43	1978	0.00007	0.00002	0.00002	5	0.0	0.0
Pentachlorophenol	Bay of Quinte - South of	44	1978	0.00002	0.00001	0.000008	5	0.0	0.0
Tetrachlorophenol	Shannonville	44	1978	0.00001	0.000008	0.000002	5	0.0	0.0
Pentachlorophenol	Bay of Quinte - South of	45	1978	0.000007	0.000004	0.000001	4	0.0	0.0
Tetrachlorophenol	Deseronto	45	1978	0.00001	0.000006	0.000002	5	0.0	0.0
Pentachlorophenol	Bay of Quinte - West of	46	1978	0.00002	0.000009	0.000008	5	0.0	0.0
Tetrachlorophenol	Mallory Bay	46	1978	0.0001	0.00002	0.00004	5	0.0	0.0
Pentachlorophenol	Bay of Quinte - South of	47	1978	0.00001	0.000009	0.000004	5	0.0	0.0
Tetrachlorophenol	Pull Point	47	1978	0.00001	0.000008	0.000004	5	0.0	0.0
Pentachlorophenol	Bay of Quinte - Northwest	48	1978	0.00002	0.00001	0.000009	5	0.0	0.0
Tetrachlorophenol	of Indian Point	48	1978	0.00004	0.00001	0.00001	5	0.0	0.0

1 Only parameters and locations exceeding objectives in some years are listed; some locations without exceedence of these parameters and some years without exceedence at these locations are also listed.

2 Location codes refer to map Figure 2.1.

3 Means are computed assuming values less than detection are equal to detection limit.

4 Water quality objectives are listed in Appendix Table A1.1, based on MOE (1984a), WHO (1984), IJC (1978, 1980, 1981, 1983a, 1985), U.S. EPA (1976, 1980).

Note: MOE objective for phenol(ics) in drinking water (2 ug/L) is lower than WHO objective for pentachlorophenol (10 ug/L). PCP concentrations from 2 to 10 ug/L are not listed in exceedence, even though they exceed the MOE phenol(ics) objective.

TABLE 3.3: MEAN CONTAMINANT CONCENTRATIONS AND YEARS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Concentration[2] (mg/L)				Years of Exceedence[3]	
			Mean	S.D.	N	P	DW	AL
Arsenic	17002600102	Moira River (1.127)	0.0159	0.0429	277	0.09	77	77
Cadmium	6018000402	Millhaven Creek (6.437)	0.00030	0.0	11	1.00		86, 87
	17000800102	Picton Creek (1.287)	0.0017	0.0013	8	0.88		86
	17000800202	Picton Marsh Cr. (0.00)	0.0014	0.0013	7	1.00		86, 87
	17001400102	Demorestville Cr. (4.828)	0.00064	0.00089	8	1.00		86, 87
	17001600102	Sawguin River (8.851)	0.00069	0.00095	7	1.00		86, 87
	17002104502	Trent River (3.862)	0.00030	0.0	8	1.00		86, 87
	17002106883	Trent River (0.805)	0.00095	0.0026	584	0.74	76, 77, 79	76, 77, 79, 8 81, 82, 83, 8 85, 86, 87
	17002600102	Moira River (1.127)	0.0015	0.0023	92	0.86	76, 79	76, 77, 78, 79, 80, 83, 84, 85, 86, 87
	17002600202	Moira River (6.276)	0.00034	0.00042	49	0.88		82, 83, 84, 85, 86, 87
	17003100102	Salmon River (2.897)	0.0022	0.0033	17	0.94	76	76, 86, 87
	17003500102	Napanee River (5.633)	0.0025	0.0034	15	0.93	76	76, 86, 87
Copper	17003500102	Napanee River (5.633)	0.0238	0.0559	86	0.22		73, 74, 76, 81, 82, 84, 85
	6018000402	Millhaven Creek (6.437)	0.0079	0.0106	69	0.04		81, 82, 83, 84, 8
	17000800102	Picton Creek (1.287)	0.015	0.0534	60	0.10		81, 82, 83, 84, 8
	17000800202	Picton Marsh Cr. (0.00)	0.0071	0.0070	27	0.04		84, 85, 86, 87
	17001400102	Demorestville Cr. (4.828)	0.0043	0.0056	62	0.10		81, 82, 83
	17001600102	Sawguin River (8.851)	0.0069	0.0133	61	0.10		83, 84
	17002106883	Trent River (0.805)	0.112	0.1240	564	0.13		76, 77, 79, 80, 82, 83
	17002600102	Moira River (1.127)	0.0079	0.0080	92	0.20		76, 77, 78, 79, 8 82, 83
	17002600202	Moira River (6.276)	0.0251	0.0312	83	0.29		73, 74, 75, 82, 83, 84, 85
Iron	17000800102	Picton Creek (1.287)	0.2460	0.2270	59	0.03	81, 82, 83	81, 82, 83
	17000800202	Picton Marsh Cr. (0.00)	0.8940	1.4600	27	0.00	84, 85, 86, 87	84, 85, 86, 87
	17001400102	Demorestville Cr. (4.828)	0.3600	0.6310	59	0.00	81, 82, 85, 87	81, 82, 85, 87
	17001600102	Sawguin River (8.851)	0.7360	1.3200	59	0.00	81, 82, 83, 84, 85, 87	81, 82, 83, 84 85, 87
	17002600102	Moira River (1.127)	0.2440	0.1580	70	0.00	76, 78, 87	76, 78, 87
	17003100102	Salmon River (2.897)	0.2160	0.0871	91	0.00	87	87
	17003500102	Napanee River (5.633)	0.3970	0.1890	83	0.00	73, 74, 75, 76, 81, 82, 86, 87	73, 74, 75, 76, 81, 82, 86, 87
Mercury	17002600202	Moira River (6.276)	0.000235	0.000439	22	0.18		83, 84
Nickel	17003100102	Salmon River (2.897)	0.0119	0.0078	7	0.86	76, 78	
	17000800102	Picton Creek (1.287)	0.0277	0.1380	52	0.75	81, 82, 83, 84, 85, 86	83, 84
	17001400102	Demorestville Cr. (4.828)	0.0023	0.0029	54	0.83	81, 82, 83, 85, 86	82
	17001600102	Sawguin River (8.851)	0.0019	0.00069	54	0.83	81, 82, 83, 84, 85, 86	
	17002104502	Trent River (3.862)	0.0028	0.0032	36	0.75	81, 83, 84, 85	
	17002106883	Trent River (0.805)	0.0135	0.0066	17	1.00	76, 77, 80, 81, 85	
	17002600102	Moira River (1.127)	0.0150	0.0057	9	0.89	76, 77, 78, 79	
	17002600202	Moira River (6.276)	0.0590	0.0247	31	0.94	73, 74, 75	73, 74, 75
	17003500102	Napanee River (5.633)	0.0457	0.0367	34	0.88	73, 74, 76, 81	73, 74

TABLE 3.3: MEAN CONTAMINANT CONCENTRATIONS AND YEARS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Concentration[2] (mg/L)				Years of Exceedence[3]	
			Mean	S.D.	N	P	DW	AL
PCB	17002106883	Trent River (0.805)	0.0245	0.0196	20	0.90		79, 80, 82, 8-85, 86
	17002600102	Moira River (1.127)	0.0205	0.0021	21	0.90		79, 80
Lead	17000800102	Picton Creek (1.287)	0.0346	0.1540	60	0.77	83, 84	83, 84
	17002106883	Trent River (0.805)	0.00883	0.0540	588	0.78		79
	17002600102	Moira River (1.127)	0.0108	0.0176	92	0.84		78, 79
	17003500102	Napanee River (5.633)	0.0051	0.0058	66	0.66		78
	17001600102	Sawguin River (8.851)	0.0062	0.0141	61	0.72		87
Phenol	17000800102	Picton Creek (1.287)	0.8470	0.9300	51	0.78		85
	17001400102	Demorestville Cr. (4.828)	0.9410	1.1200	51	0.75		82, 85
	17001600102	Sawguin River (8.851)	2.4700	8.1500	53	0.74	82, 85	82, 85
	17002104502	Trent River (3.862)	0.6720	0.6740	36	0.69		81, 86
	17002106883	Trent River (0.805)	1.4300	1.2900	27	0.63	77	76, 77
	17002600102	Moira River (1.127)	0.6850	0.5170	59	0.75		76, 78, 82
	17002600202	Moira River (6.276)	1.6300	1.3200	34	0.47	73	73, 74, 76
	17003100102	Salmon River (2.897)	0.7750	0.4920	87	0.76		77, 82
	17003500102	Napanee River (5.633)	1.6700	1.3800	65	0.46	73, 74	73, 74, 82
Zinc	6018000402	Millhaven Creek (6.437)	0.0082	0.0095	69	0.01		87
	17000800102	Picton Creek (1.287)	0.3300	2.4500	59	0.15		84, 86
	17000800202	Picton Marsh Cr. (0.00)	0.0210	0.0261	27	0.00		84
	17002600202	Moira River (6.276)	0.0227	0.0221	83	0.27		73, 74, 75
	17003500102	Napanee River (5.633)	0.0226	0.0396	86	0.19		73, 74, 76

1 Only parameters and locations exceeding objectives in some years are listed.

2 Means are computed assuming trace values (with T flags) are as reported and values less than detection limit (W flags) are equal to the detection limit. P is proportion of observations (N) with T or W flags. Phenol and PCB in ug/L. Means represent entire multiple year surveillance period.

3 Years in which annual means exceeded objectives (Appendix Table A1.1).

Figure 3.1 : Annual Mean Total Copper at Millhaven Creek (6.437 km)

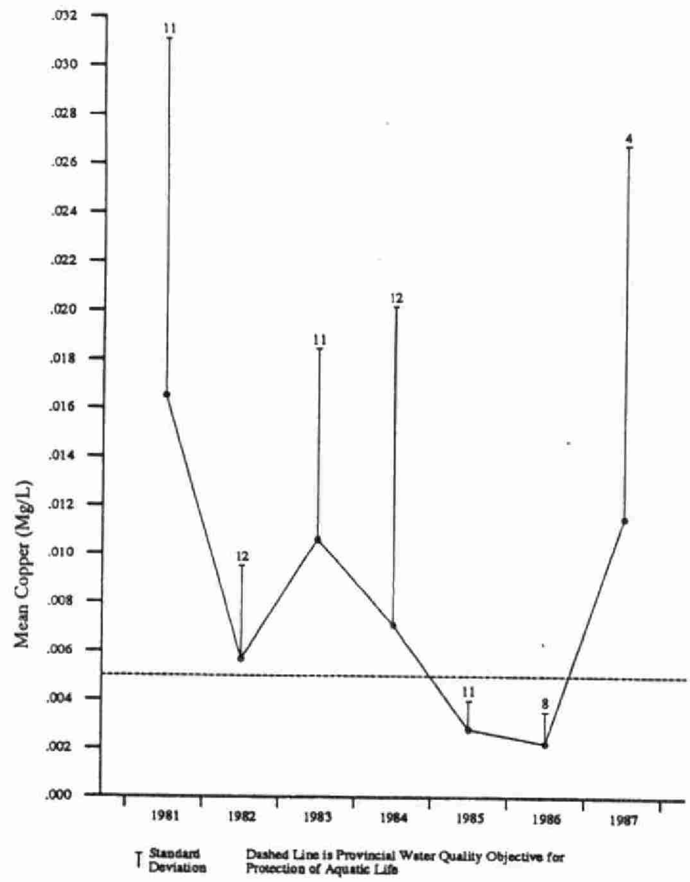

Figure 3.2 : Annual Mean Total Iron at Picton Creek (1.287 km)

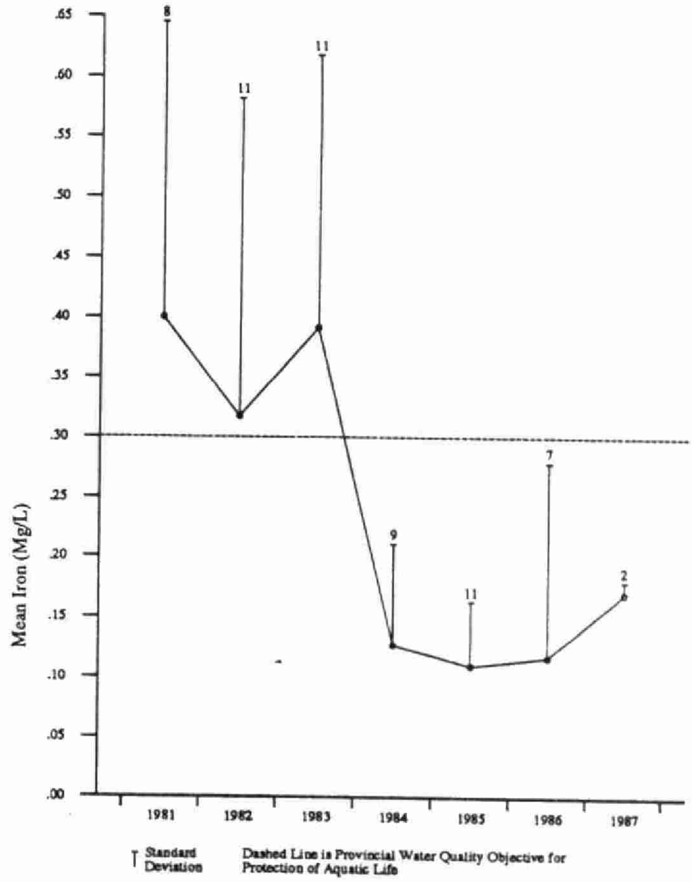

Figure 3.3 : Annual Mean Total Copper at Demorestville Creek (4.828 km)

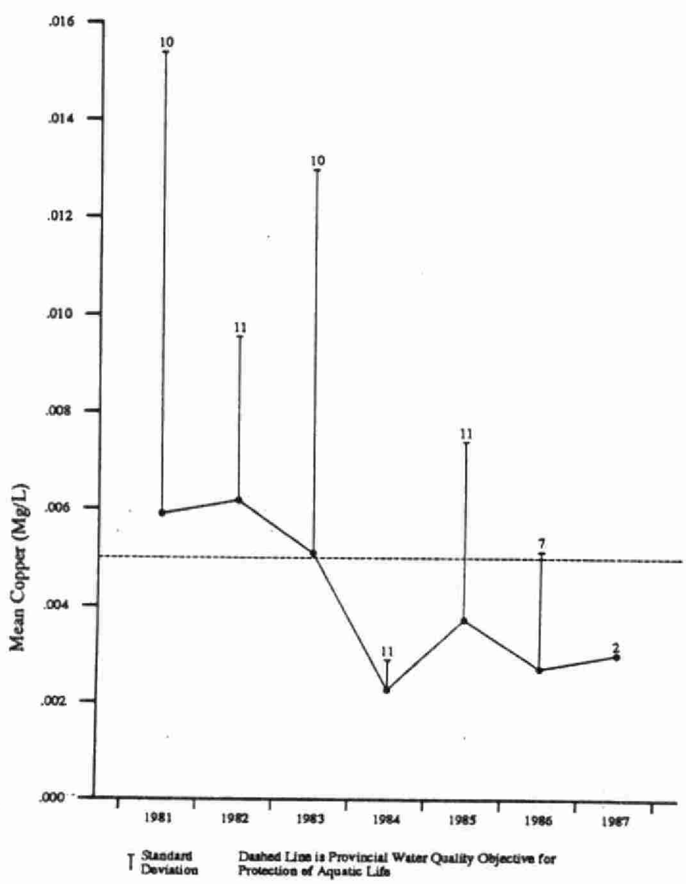

Figure 3.4 : Annual Mean Total Cadmium at Trent River (0.805 km)

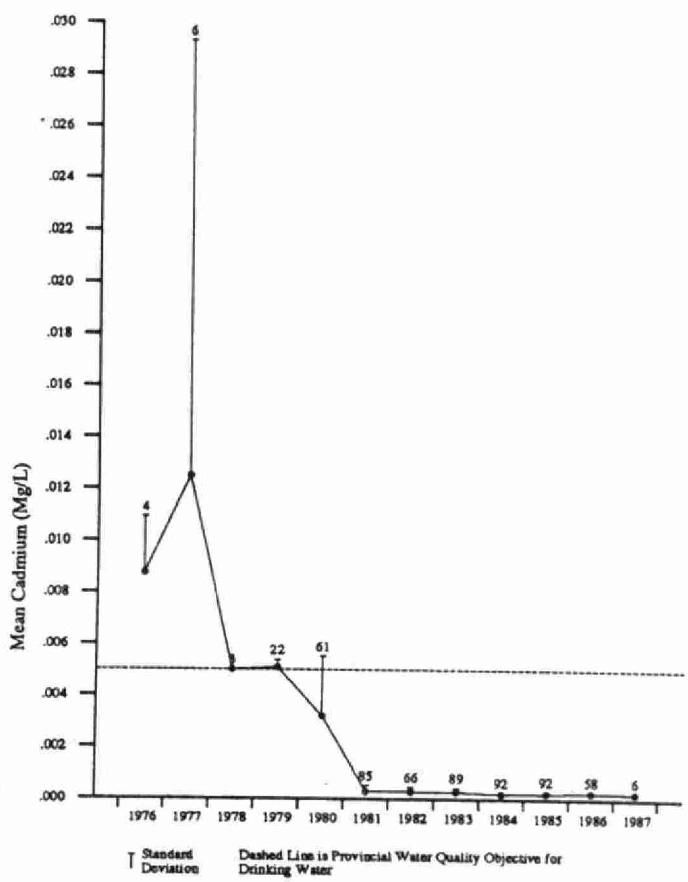

Figure 3.5 : Annual Mean Total Cadmium at Moira River (1.127 km)

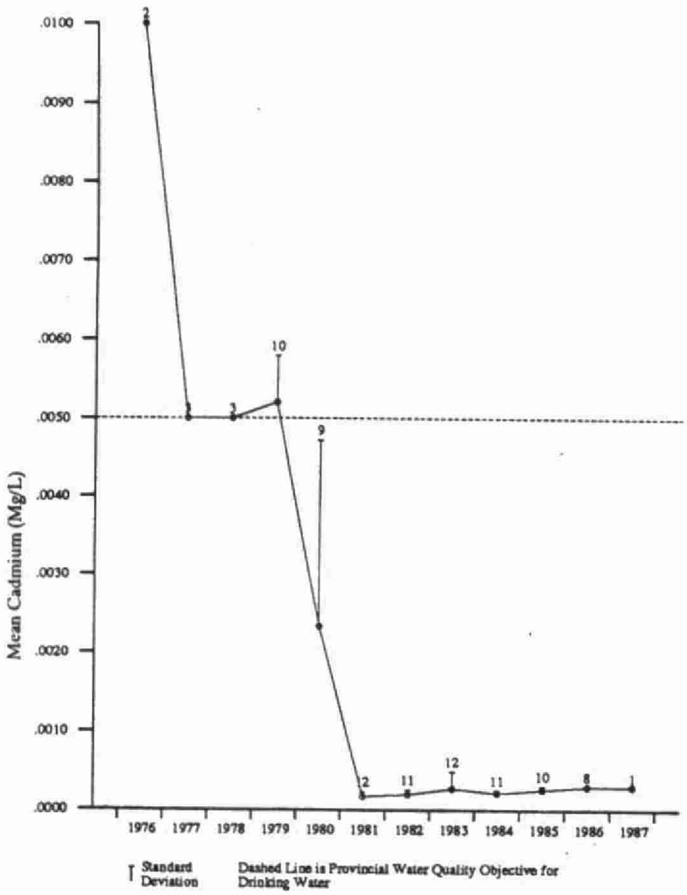

Figure 3.6 : Annual Mean Total Copper at Moira River (1.127 km)

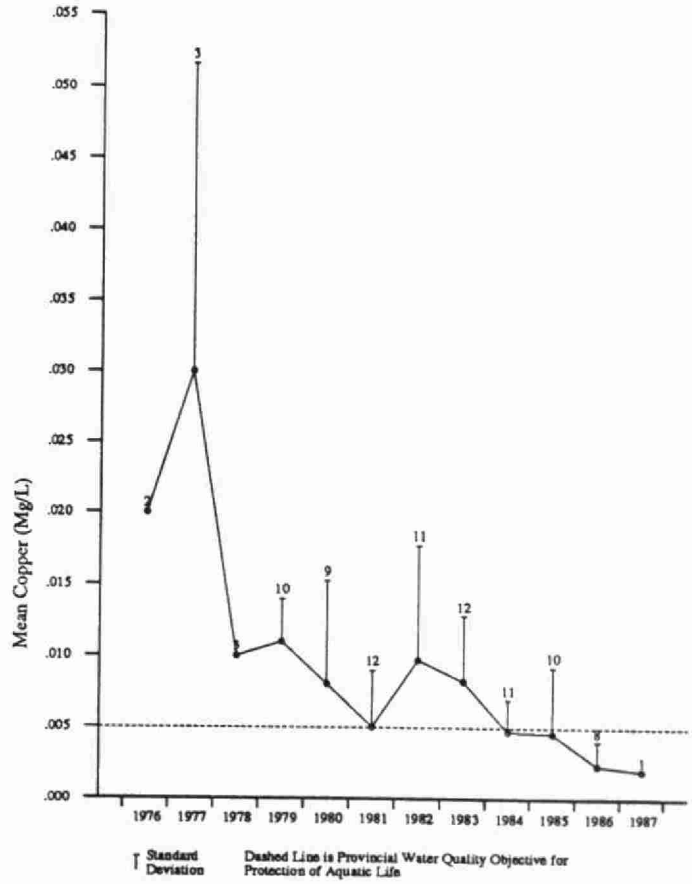

Figure 3.7 : Annual Mean Phenolics at Moira River (1.127 km)

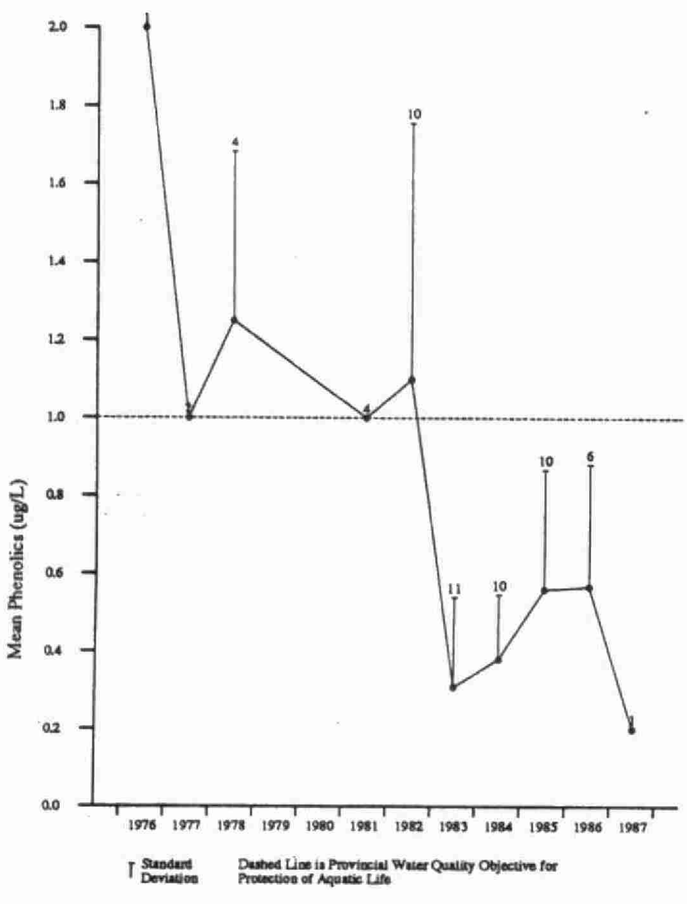

Figure 3.8 : Annual Mean Total Copper at Moira River (6.276 km)

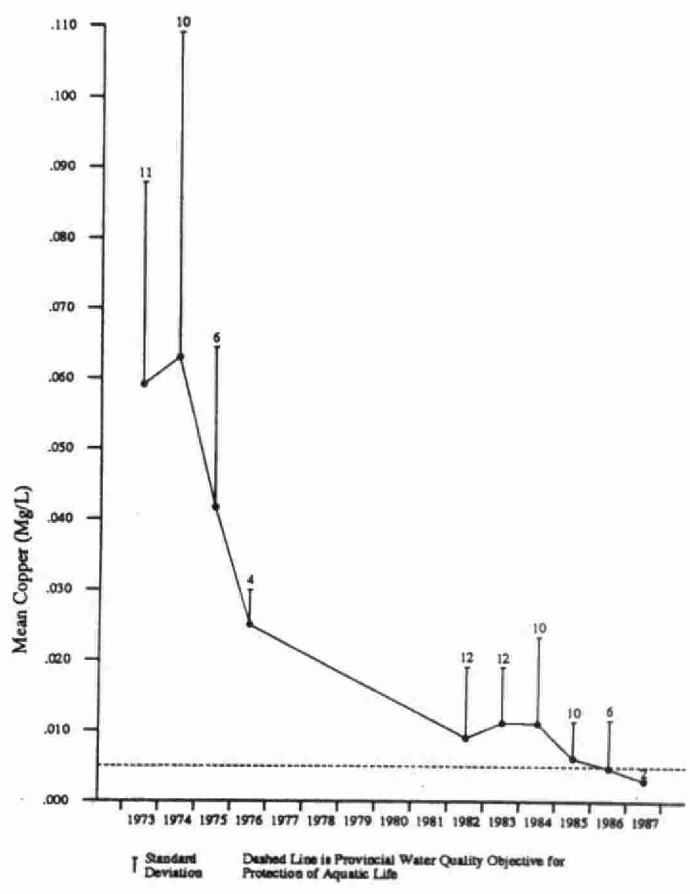

Figure 3.9 : Annual Mean Phenolics at Moira River (6.276 km)

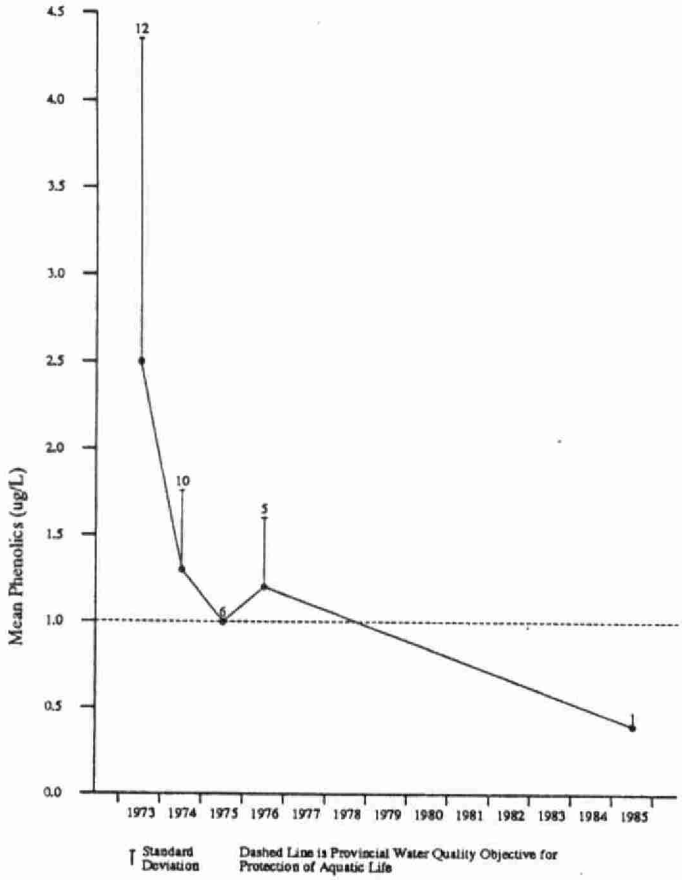

Figure 3.10: Annual Mean Total Zinc at Moira River (6.276 km)

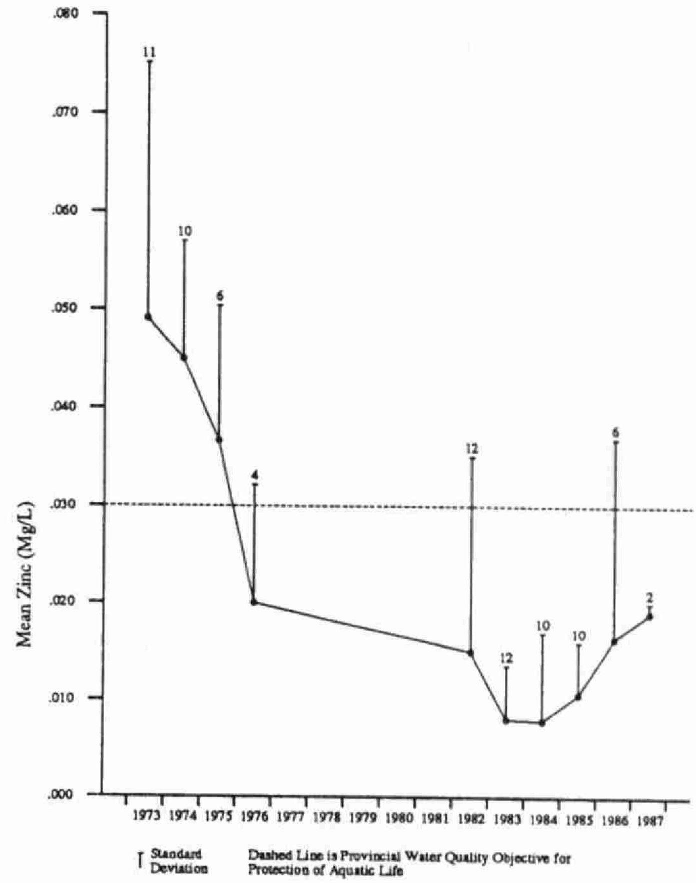

Figure 3.11: Annual Mean Total Cadmium at Salmon River (2.897 km)

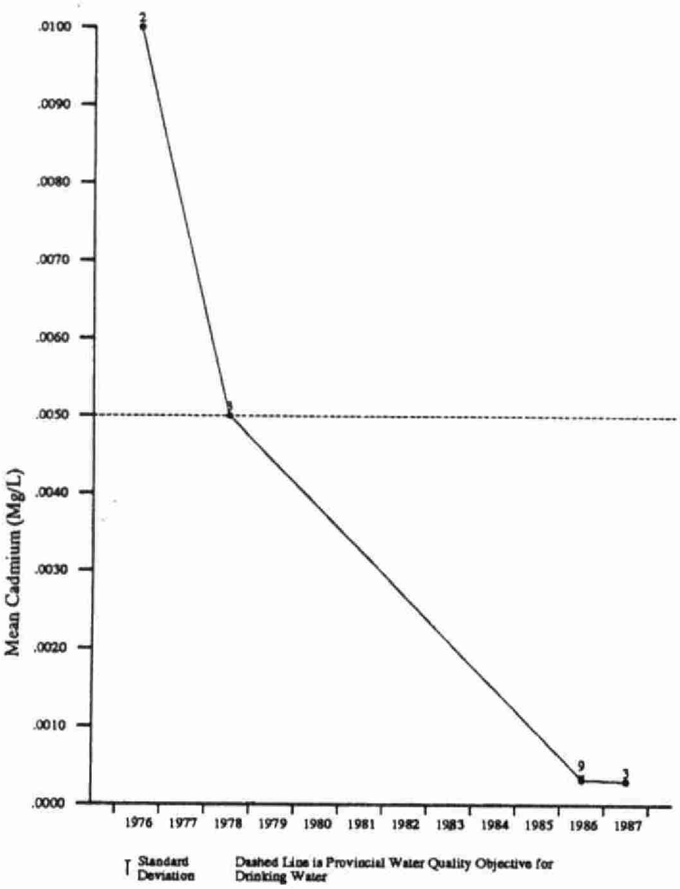

Figure 3.12: Annual Mean Total Phenolics at Salmon River (2.897 km)

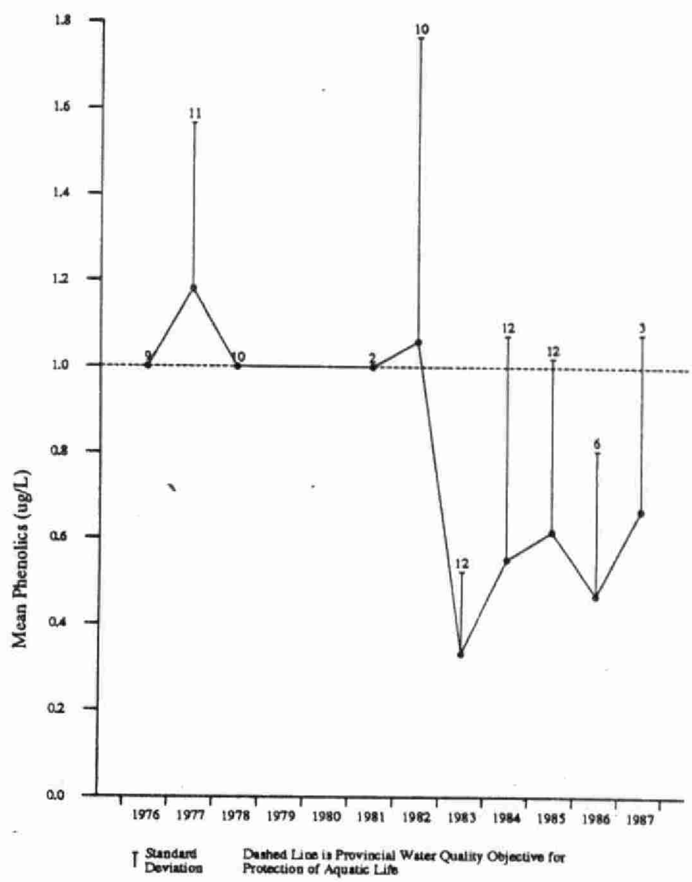

Figure 3.13: Annual Mean Total Cadmium at Napanee River (5.633 km)

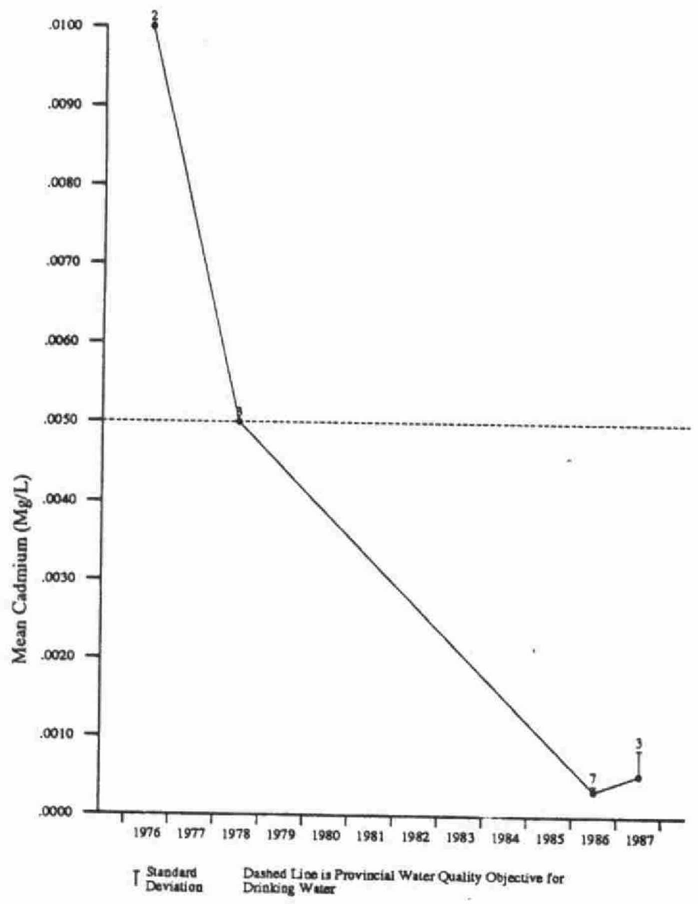

Figure 3.14: Annual Mean Total Copper at Napanee River (5.633 km)

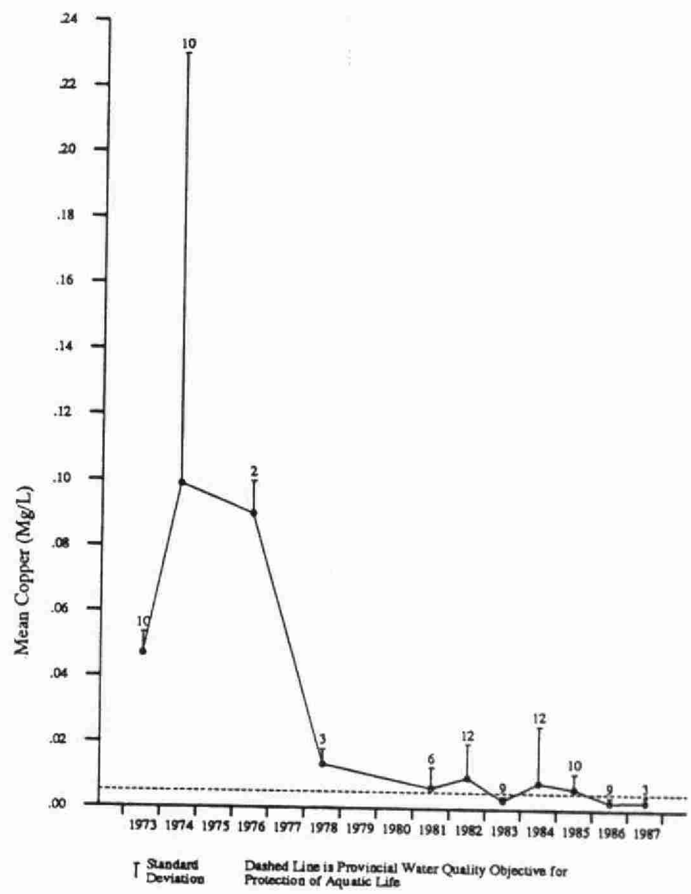

Figure 3.15: Annual Mean Total Nickel at Napanee River (5.633 km)

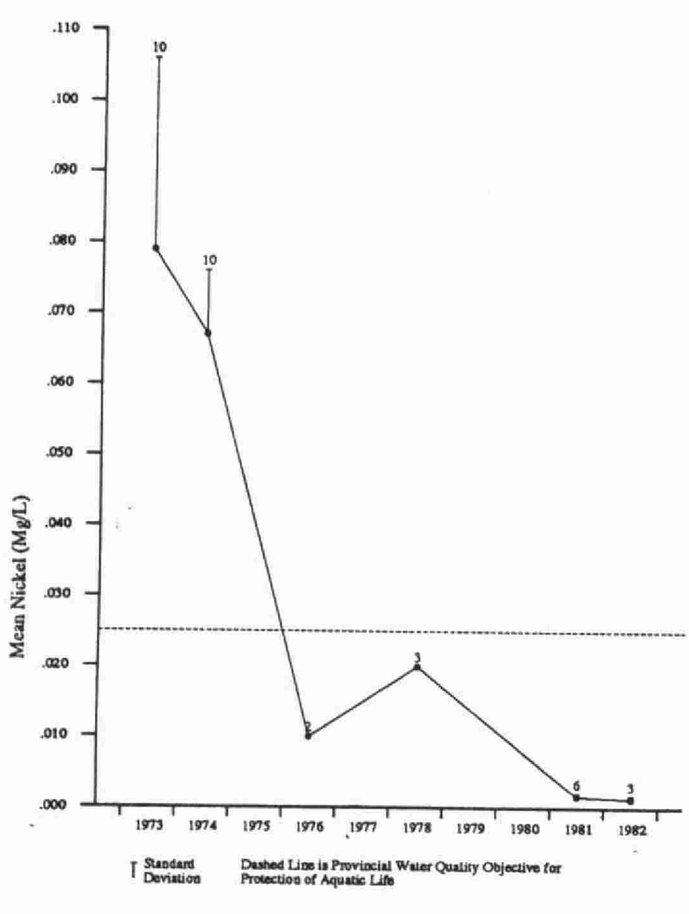

Figure 3.16: Annual Mean Total Lead at Napanee River (5.633 km)

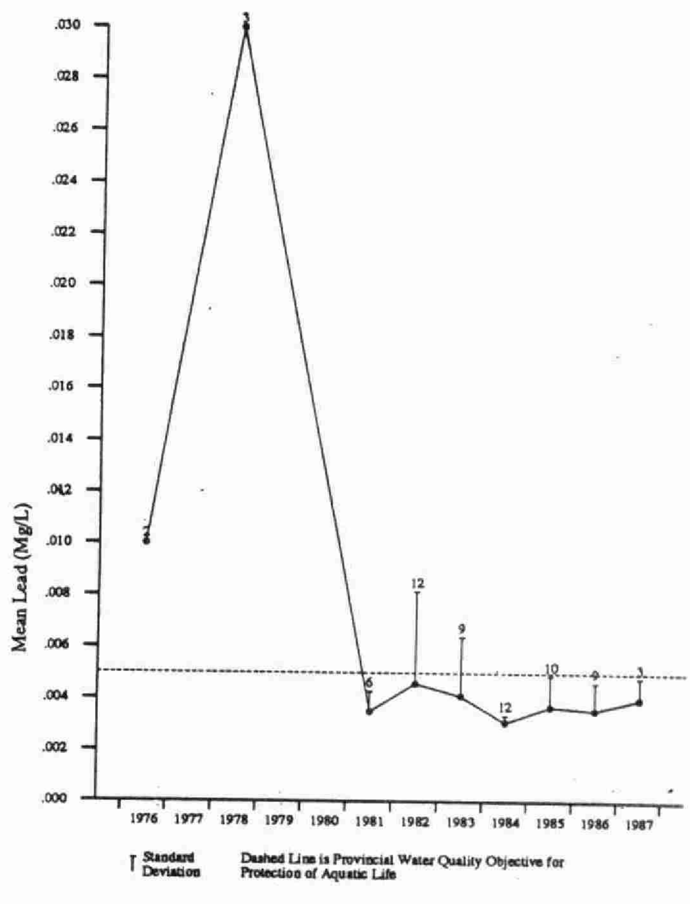

Figure 3.17: Annual Mean Total Zinc at Napanee River (5.633 km)

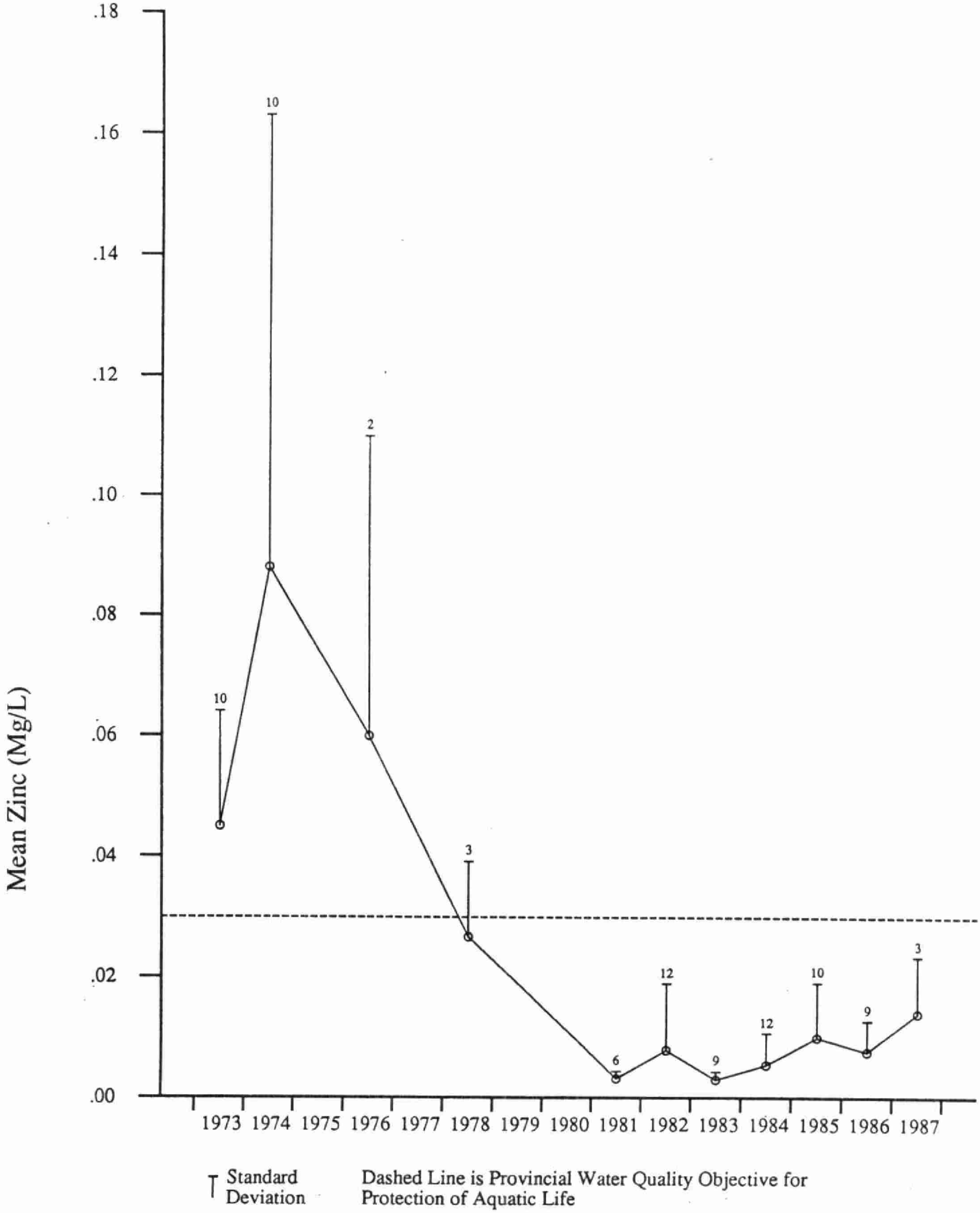

TABLE 4.1: SEDIMENT QUALITY DATA SOURCES

Location	Code[1]	Year	No. of Sample Stations	Type	Parameter	Reference
Big Bay Section, Bay of Quinte	6	1970*	3	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Fe, Pb, Mn, Ni, Sr, V, Zn, Ca, K, Mg	Damiani et al. (1973)
Average Bay of Quinte (location unspecified)	5	1972	-	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Big Bay	6	1972	-	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Telegraph Narrows	16	1972	1	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Glenora Ferry	24	1972	2	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Green Point	23	1972	2	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Adolphus Reach	25	1972	1	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Indian Point	26	1972	1	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Average Brothers Island	22	1972	2	Ferromanganese nodules	Be, Cd, Co, Cu, Cr, Pb, Mg, Ni, Sr, V, Zn, K	Damiani et al. (1977)
Bay of Quinte - near Glenora	2	1970*	10	Ferromanganese nodules	Pr, B, Se, V, Cr, Co, Ni, Cu, Zn, Ga, Ge, As, Sc, Pb, U, Rb, Sr, Y, Zr, Nb, Mo, Ag, Cd, In, Sn, Sb, Cs, Ba, La, Th, Hg, Ce, Nd, Tm, Yb, Sm, Eu, Gd, Ho, Tb, Er, Dy, Hf, Tl, Be	Fyfe et al. (1980)
Bay of Quinte (location unspecified)	5	1972	214**	Surficial	PCB	Frank et al. (1980)
Wilton Creek	39	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)
Napanee River	29	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)
Salmon River	11	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)
Moira River	13	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)
Trent River	28	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)

TABLE 4.1: SEDIMENT QUALITY DATA SOURCES

Location	Code[1]	Year	No. of Sample Stations	Type	Parameter	Reference
Millhaven Creek	27	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)
Collins Creek	30	1974	1	Suspended solids	DDT, dieldrin, endosulfan, heptachlor epoxide, hexachlorobenzene, PCB	Frank et al. (1981)
Bay of Quinte	5.1-5.4	1982	72	Surficial	As, Cd, Cu, Cr, Fe, Pb, Ni, Zn, Hg	MOE (1982)
Bay of Quinte	5.1-5.4	1982	49	Surficial	Aldrin, BHC, chlordane, dieldrin, methoxychlor, endrin, endosulfan sulphate, endosulfan, 2,4-d-propionic acid, silvex, heptachlor epoxide, heptachlor, mirex, DDT, PCB, hexachlorobenzene	MOE (1982)
Bay of Quinte - near Belleville	1.2	1985	4	Surficial	Al, As, Cd, Cu, Cr, Fe, Pb, Mn, Hg, Ni, Zn, solvent extractables, aldrin, BHC, chlordane, dieldrin, methoxychlor, endosulfan, endrin, endosulfan sulphate, heptachlor epoxide, heptachlor, mirex, DDT, PCB, hexachlorobenzene, % LOI, TOC, particle size	Persaud (1987)
Bay of Quinte - near Trenton	4	1985	4	Surficial		
Napanee River Mouth	29	1973	3	Surficial	Cd, Co, Cu, Cr, Pb, Mn, Hg, Ni, Ag, Zn, % LOI, particle size	Fitchko (1974a), Fitchko and Hutchinson (1975)
Napanee River Mouth	29	1973	2	Core	Cd, Co, Cu, Cr, Pb, Mn, Ni, Ag, Zn	Fitchko (1974b)
Moira River Mouth	13	1973	2	Surficial	Cd, Co, Cu, Cr, Pb, Mn, Hg, Ni, Ag, Zn, % LOI, particle size	Fitchko (1974a), Fitchko and Hutchinson (1975)
Moira River Mouth	13	1973	2	Core	Cd, Co, Cu, Cr, Pb, Mn, Ni, Ag, Zn	Fitchko (1974b)
Trent River Mouth	28	1973	3	Surficial	Cd, Co, Cu, Cr, Pb, Mn, Hg, Ni, Ag, Zn, % LOI, particle size	Fitchko (1974a), Fitchko and Hutchinson (1975)
Trent River Mouth	28	1973	1	Core	Cd, Co, Cu, Cr, Pb, Mn, Ni, Ag, Zn	Fitchko (1974b)
Bay of Quinte - Long Reach	41	1976, 77, 79	13	Surficial, Core	Ag, Al, B, Ba, Cd, Cr, Cu, Fe, Ga, Hg, Mn, Mo, Ni, Pb, V, Zn, DDT, BHC, mirex, chlordane, heptachlor, heptachlor epoxide, PCB, aldrin, dieldrin, endrin, hexachlorobenzene	Ontario Hydro (1977, 1978, 1980)
Bay of Quinte - South of Belleville	17	1977	1	Surficial	Pb, Co, Ni, Cu, Zn, Cr, Ag, As, Hg	Mudroch and Capobianco (1980)
Bay of Quinte at Moira River	13	1982	5	Surficial	PAHs	Stride (1977)

1 Location codes refer to map Figure 2.1, except Code 5 (unspecified location).
* Samples were collected between 1969 and 1972; specific dates were not given.
** Only an average value is reported and included in the database.
\- Dash indicates number of stations not stated.

TABLE 4.2: PERCENT EXCEEDENCE OF DREDGE SPOIL DISPOSAL CRITERIA AND SURFICIAL SEDIMENT BACKGROUND LEVELS BY LOCATION IN THE BAY OF QUINTE

Chemical Parameter[1]	Location	Code[2]	Year	Concentration[3] (ug/g) Max	Mean	S.D.	N	% Exceedence[4] Dredge Disposal	Background
Arsenic	Bay of Quinte at Belleville	1.2	1985	24.7	14.76	8.35	4	0.0	0.0
Cadmium		1.2	1985	3.4	1.95	1.32	4	75	0.0
Chromium		1.2	1985	83	62	29.74	4	75	0.0
Copper		1.2	1985	94	58.5	35.18	4	75	0.0
Iron		1.2	1985	28,000	21,200	10,342	4	75	0.0
Mercury		1.2	1985	0.73	0.46	0.29	4	75	25
Nickel		1.2	1985	41	28.7	14.33	4	75	0.0
Lead		1.2	1985	120	80.75	47.40	4	75	75
Zinc		1.2	1985	340	222	124.58	4	75	75
PCB		1.2	1985	0.32	0.2	0.12	4	75	75
Arsenic	Bay of Quinte at Trenton	4	1985	6.48	2.8	2.54	4	0.0	0.0
Cadmium		4	1985	0.53	0.34	0.17	4	0.0	0.0
Chromium		4	1985	200	72.75	85.96	4	50	25
Copper		4	1985	34	18.4	11.08	4	25	0.0
Iron		4	1985	16,000	11,300	5,770	4	50	0.0
Mercury		4	1985	0.2	0.08	0.08	4	0.0	0.0
Nickel		4	1985	15	10.07	3.43	4	0.0	0.0
Lead		4	1985	190	69.17	82.06	4	25	50
Zinc		4	1985	440	171	182	4	50	25
PCB		4	1985	0.115	0.068	0.047	3	66	33
PCB	Bay of Quinte (average)	5	1972	-	0.048	-	214	0.0	0.0
Arsenic	Bay of Quinte (Trenton vicinity)	5.1	1982	6.09	3.18	1.74	25	0.0	0.0
Cadmium		5.1	1982	1.8	0.99	0.45	25	48	0.0
Chromium		5.1	1982	94	59.3	27.8	25	84	24
Copper		5.1	1982	55	34.67	14	25	80	0.0
Iron		5.1	1982	26,000	17,972	6,419	25	84	0.0
Mercury		5.1	1982	0.69	0.326	0.166	25	52	0.0
Nickel		5.1	1982	23	14.26	5.89	25	0.0	0.0
Lead		5.1	1982	110	68	30.66	25	68	88
Zinc		5.1	1982	220	150.19	66.72	25	72	48
PCB		5.1	1982	0.32	0.193	0.087	9	90	80
Arsenic	Bay of Quinte (Belleville vicinity)	5.2	1982	260	24.67	47.31	27	0.0	0.0
Cadmium		5.2	1982	4.2	2.72	1.04	25	88	16
Chromium		5.2	1982	85	64.16	16.79	25	92	0.0
Copper		5.2	1982	99	61.79	21.88	25	92	0.0
Iron		5.2	1982	39,000	26,384	5,578	25	96	0.0
Mercury		5.2	1982	0.82	0.558	0.181	25	88	12
Nickel		5.2	1982	43	32.43	9.77	25	80	0.0
Lead		5.2	1982	150	120.8	30.45	25	96	96
Zinc		5.2	1982	370	272.8	76.17	24	96	92
PCB		5.2	1982	0.32	0.172	0.0834	18	89	84
Arsenic	Bay of Quinte (Deseronto vicinity)	5.3	1982	19.3	13.63	4.15	11	0.0	0.0
Cadmium		5.3	1982	1.5	1.144	0.3397	11	73	0.0
Chromium		5.3	1982	59	47.72	7.938	11	100	0.0
Copper		5.3	1982	41	35.45	4.412	11	100	0.0
Iron		5.3	1982	29,000	26,090	2,508	11	100	0.0
Mercury		5.3	1982	0.4	0.343	0.0388	11	82	0.0
Nickel		5.3	1982	40	32.9	5.95	11	91	0.0
Lead		5.3	1982	100	82.81	14.93	11	100	100
Zinc		5.3	1982	230	197.27	24.93	11	100	91
PCB		5.3	1982	0.29	0.09	0.072	10	80	40
Arsenic	Bay of Quinte (Picton vicinity)	5.4	1982	27.9	12.31	6.06	9	0.0	0.0
Cadmium		5.4	1982	1.1	0.797	0.236	10	20	0.0
Chromium		5.4	1982	79	60.3	15.29	10	100	0.0
Copper		5.4	1982	48	37.5	8.209	10	90	0.0
Iron		5.4	1982	35,000	27,400	7,167	10	100	0.0
Mercury		5.4	1982	0.27	0.195	0.061	10	0.0	0.0
Nickel		5.4	1982	69	46.4	14.4	10	90	50
Lead		5.4	1982	110	80.9	18.78	10	100	100
Zinc		5.4	1982	220	171.5	51.1	10	90	50
PCB		5.4	1982	0.18	0.08	0.049	9	50	40
Nickel	Moira River Mouth	13	1973	27	26.25	1.06	2	100	0.0
Zinc		13	1973	172.5	147.75	35.001	2	100	50
Lead		13	1973	80	73	35.00	2	100	100
Cadmium		13	1973	3.8	3.5	0.283	2	100	50
Copper		13	1973	33.3	30.4	4.03	2	100	0.0
Mercury		13	1973	0.200	0.190	0.014	2	0.0	0.0
Chromium		13	1973	14.8	14.55	0.353	2	0.0	0.0

TABLE 4.2: PERCENT EXCEEDENCE OF DREDGE SPOIL DISPOSAL CRITERIA AND SURFICIAL SEDIMENT BACKGROUND LEVELS BY LOCATION IN THE BAY OF QUINTE

Chemical Parameter[1]	Location	Code[2]	Year	Concentration[3] (ug/g) Max	Mean	S.D.	N	% Exceedence[4] Dredge Disposal	Background
Copper	Trent River Mouth	28	1973	87.9	72.30	14.66	3	100	0.0
Cadmium		28	1973	3.8	3.50	0.361	3	100	33
Mercury		28	1973	0.520	0.470	0.045	3	100	0.0
Lead		28	1973	149.5	135.0	12.61	3	100	100
Zinc		28	1973	168.5	128	39.77	3	67	33
Nickel		28	1973	13.80	12.93	1.026	3	0.0	0.0
Chromium		28	1973	20.90	16.50	3.89	3	0.0	0.0
Cadmium	Napanee River Mouth	29	1973	2.7	2.6	0.05	3	100	0.0
Zinc		29	1973	195.5	178	19.48	3	100	67
Nickel		29	1973	29.8	28.1	1.53	3	100	0.0
Chromium		29	1973	43.9	38	7.786	3	100	0.0
Copper		29	1973	31.4	28.8	4.417	3	67	0.0
Mercury		29	1973	0.230	0.210	0.017	3	0.0	0.0
Lead		29	1973	47.2	42.1	6.285	3	0.0	100
Chromium	Bay of Quinte South of Belleville	17	1977	82	82	0.0	1	100	0.0
Copper		17	1977	87	87	0.0	1	100	0.0
Mercury		17	1977	0.65	0.65	0.0	1	100	0.0
Arsenic		17	1977	15	15	0.0	1	0.0	0.0
Nickel		17	1977	107	107	0.0	1	100	100
Lead		17	1977	150	150	0.0	1	100	100
Zinc		17	1977	323	323	0.0	1	100	100
Iron	Bay of Quinte - Long Reach	41	1976	34,000	32,166	1,834.8	6	100	0.0
Cadmium		41	1976	1.70	1.53	0.23	6	46	0.0
Chromium		41	1976	56	52.66	2.33	6	100	0.0
Copper		41	1976	40	39.33	0.816	6	100	0.0
Mercury		41	1976	0.220	0.145	0.041	6	0.0	0.0
Arsenic		41	1976	24.00	16.83	3.81	6	100	0.0
Nickel		41	1976	48.00	40.33	4.76	6	100	0.0
Lead		41	1976	88	84.16	6.04	6	100	100
Zinc		41	1976	270	241.6	19.40	6	100	100
Chromium	Bay of Quinte - Long Reach	41	1977	51	46.40	3.02	10	100	0.0
Copper		41	1977	42	38.8	3.76	10	100	0.0
Mercury		41	1977	0.442	0.396	0.046	10	90	0.0
Arsenic		41	1977	19.50	13.68	3.10	9	0.0	0.0
Nickel		41	1977	107	47.50	5.01	10	100	40
Lead		41	1977	102	92.40	9.60	10	100	100
Zinc		41	1977	242	230.30	8.70	10	100	100
PCB		41	1977	0.624	0.385	0.142	10	100	100
Chromium	Bay of Quinte - Long Reach	41	1979	33	20.02	13.88	4	50	0.0
Copper		41	1979	27	15.75	11.47	4	25	0.0
Mercury		41	1979	0.24	0.125	0.10	4	0.0	0.0
Arsenic		41	1979	7.3	4.45	2.55	4	0.0	0.0
Nickel		41	1979	36	23.25	13.14	4	50	0.0
Lead		41	1979	58	36.25	20.12	4	25	50
Zinc		41	1979	143	84	56.57	4	50	0.0
PCB		41	1979	0.038	0.016	0.015	4	0.0	0.0

[1] Only parameters and locations exceeding criteria or Lake Ontario background in some years are listed; some years without exceedence at these locations are also listed.

[2] Location codes refer to map Figure 2.1.

[3] Means are computed assuming values less than detection are equal to the detection limit.

[4] Criteria and background levels are listed in Appendix Table A1.1, based on Persaud and Wilkins (1975) and Mudroch et al. (1986).

TABLE 5.1: CONTAMINANTS IN FISH DATA SOURCES

Location	Code[1]	Year	Fish Species	Parameters	Reference
Bay of Quinte (location unspecified)	5	1971-1986	Northern pike, walleye, yellow perch, brown bullhead, sheepshead, white perch, channel catfish, American eel, carp	DDT, PCB, Hg	Shum (1987)
Bay of Quinte (location unspecified)	5	1968	Northern pike, redhorse sucker, white perch, white bass, smallmouth bass, black crappie, yellow perch, walleye	DDT	Johnson (1987)
Bay of Quinte (location unspecified)	5	1969	Alewife, gizzard shad, northern pike, brown bullhead, white perch, rock bass, smallmouth bass, largemouth bass, yellow perch	DDT, dieldrin	Johnson (1987)
Bay of Quinte, near Belleville	1.2	1975	White bass, white perch, black crappie, walleye, sheepshead, northern pike, carp, channel catfish, American eel, smallmouth bass, largemouth bass	Dieldrin, chlordane, heptachlor, aldrin, heptachlor epoxide, DDT, HCB, BHC, mirex, PCB, As, Cu, Mn, Hg, Zn	Johnson (1987)
Salmon River Mouth	12	1977	Spottail shiner	PCB, DDT, BHC, chlordane, Hg	Suns et al. (1978)
Bay of Quinte - Glenora	2	1975	Spottail shiner	PCB, DDT, BHC, chlordane	Suns et al. (1985)
Bay of Quinte (location unspecified)	5	1982	Walleye	Hg, Cu, Ni, Zn, Pb, Cd, Cr, As, Se, HCB, mirex, PCB, chlordane, dieldrin, DDT	Whittle (1987)
Salmon River	11	1977	Golden shiner	PCB, DDT, BHC, chlordane, Hg	Suns et al. (1978)
Moira River (Belleville)	13	1978	Yellow perch	PCB, DDT, mirex, BHC, chlordane, Hg	Suns (1987)
Trenton Bay at Trenton	20	1979, 1981, 1982, 1985, 1986	Yellow perch	PCB, DDT, mirex, BHC, chlordane, Hg, chlorophenols, chlorobenzenes	Suns (1987)
Trent River at Trenton	14	1981	Yellow perch	PCB, HCB, heptachlor, aldrin, DDT, mirex, octochlorostyrene, BHC, Hg	Johnson (1987)
Bay of Quinte near Belleville	1.2	1976	Smallmouth bass	Hg, Cu, Zn, HCB, As	Johnson (1987)
Baker Island	3	1976	Smallmouth bass	Hg, Cu, Zn, HCB, As	Johnson (1987)
Bay of Quinte at Trenton	4	1976	Smallmouth bass	Hg, Cu, Zn, HCB, As	Johnson (1987)
Bay of Quinte - Hay Bay	7	1976	Smallmouth bass	Hg, Cu, Zn, HCB, As	Johnson (1987)
Bay of Quinte, near Belleville	1.2	1976	Rainbow smelt	HCB, BHC, heptachlor epoxide, dieldrin, endrin, DDT, chlordane, mirex, PCB	Johnson (1987)
Bay of Quinte, near Belleville	1.2	1977	Carp	PCB, HCB, BHC, DDT, chlordane, mirex, Hg	Johnson (1987)
Bay of Quinte, Picton Bay	10	1977	Rainbow smelt	PCB, HCB, BHC, DDT, chlordane, mirex	Johnson (1987)
Bay of Quinte (location unspecified)	5	1979	Channel catfish	PCB, mirex	Johnson (1987)
Bay of Quinte, Hay Bay	7	1980	Yellow perch, brown bullhead, channel catfish, sheepshead, gizzard shad, white perch	Hg, PCB, HCB, heptachlor, aldrin, mirex, DDE	Johnson (1987)
Bay of Quinte (location unspecified)	5	1980	Yellow perch, white perch	Dioxin	Niagara River Toxics Committee (1984)
Trent River Below #1 Dam	15	1981	Walleye	Hg, PCB, HCB, heptachlor, aldrin, DDT, mirex, octachlorostyrene, BHC, chlordane	Johnson (1987)

TABLE 5.1: CONTAMINANTS IN FISH DATA SOURCES

Location	Code[1]	Year	Fish Species	Parameters	Reference
Bay of Quinte, Hay Bay	7	1981	American eel	Hg, PCB, HCB, heptachlor, aldrin, DDT, mirex, octachlorostyrene, BHC, chlordane	Johnson (1987)
Bay of Quinte, Deseronto	18	1981	Largemouth bass, smallmouth bass	Hg	Johnson (1987)
Bay of Quinte, Glenora Upper Gap	19	1982	American eel, whitefish	Hg, PCB, HCB, heptachlor, aldrin, DDT, mirex, octachlorostyrene, BHC, chlordane	Johnson (1987)

[1] Location codes refer to map Figure 2.1.

TABLE 5.2: PERCENT EXCEEDENCE OF FISH CONSUMPTION GUIDELINES BY FISH SPECIES IN THE BAY OF QUINTE

Chemical Parameter[1]	Species[1]	Year[1]	Concentration[2] (ug/g) Max	Mean	S.D.	N	% Exceedence Fish Consumption[3]	Years with No Exceedence
PCB	American Eel	1973	16.70	16.70	0.0	1	100	
PCB	American Eel	1975	5.20	2.61	1.31	12	67	
Mercury	American Eel	1975	0.61	0.32	0.23	11	36	1973, 1979, [illegible] 1982, 198[illegible]
PCB	American Eel	1976	7.85	7.85	0.0	1	100	
PCB	American Eel	1980	4.01	4.01	0.0	1	100	
PCB	American Eel	1982	7.23	3.51	1.97	20	80	1981, 198[illegible]
Mirex	American Eel	1982	0.60	0.21	0.15	19	60	1981
PCB	American Eel	1983	2.06	2.06	0.0	1	100	
PCB	American Eel	1985	2.66	2.66	0.0	1	100	
PCB	American Eel	1986	2.94	2.94	0.0	1	100	
PCB	Carp	1974	2.05	2.05	0.0	1	100	1975, 1976, [illegible]
PCB	Carp	1977	2.89	0.94	0.77	21	14	
PCB	Carp	1979	2.30	2.30	0.0	1	100	
PCB	Channel Catfish	1975	12.58	2.37	4.15	8	13	
Mercury	Channel Catfish	1975	1.12	0.47	0.52	7	43	1973, 1976, 19[illegible] 1984, 1985, [illegible]
PCB	Channel Catfish	1976	9.26	9.26	0.0	1	100	
PCB	Channel Catfish	1979	5.15	2.20	1.14	26	58	
PCB	Channel Catfish	1980	3.63	1.42	1.49	4	25	
PCB	Channel Catfish	1983	10.00	10.00	0.0	1	100	1985
PCB	Channel Catfish	1984	3.95	3.95	0.0	1	100	
PCB	Channel Catfish	1986	2.82	2.82	0.0	1	100	
Mercury	Largemouth Bass	1975	0.88	0.40	0.34	5	40	
Mercury	Largemouth Bass	1981	0.62	0.34	0.17	16	19	-
Mercury	Northern Pike	1973	0.59	0.59	0.0	1	100	1971, 1976, 19[illegible]
Mercury	Northern Pike	1975	0.79	0.40	0.14	12	8	
PCB	Northern Pike	1975	2.20	1.60	0.60	12	33	1973, 1976, 19[illegible] 1986
Mirex	Rainbow Smelt	1976	0.25	0.14	0.06	16	88	-
PCB	Rainbow Smelt	1976	2.70	1.55	0.46	16	13	1977
Mirex	Rainbow Smelt	1977	0.84	0.16	0.24	10	20	
DDT	Smallmouth Bass	1968	15.69	9.06	9.38	2	50	1969
Mercury	Smallmouth Bass	1975	1.10	0.52	0.36	10	40	-
Mercury	Smallmouth Bass	1976	0.95	0.36	0.28	20	25	
Mercury	Smallmouth Bass	1981	0.78	0.40	0.32	5	40	
PCB	Sheepshead	1975	4.11	1.49	2.27	3	33	1978, 1980, 19[illegible]
PCB	Sheepshead	1976	4.91	4.91	0.0	1	100	
Mercury	Sheepshead	1976	0.56	0.56	0.0	1	100	1975
Mercury	Sheepshead	1984	0.71	0.71	0.0	1	100	
Mercury	Walleye	1971	1.36	1.36	0.0	1	100	
Mercury	Walleye	1975	1.49	0.35	0.35	14	7	1976, 1980, 19[illegible]
PCB	Walleye	1976	2.67	2.67	0.0	1	100	1972, 1978, 19[illegible]
PCB	Walleye	1979	3.76	3.76	0.0	1	100	
PCB	Walleye	1981	3.13	0.42	0.52	52	2	
Mercury	Walleye	1981	2.10	0.19	0.28	72	4	
Mirex	Walleye	1981	0.32	0.03	0.06	31	4	1982
PCB	Walleye	1982	2.59	2.59	0.0	1	100	
PCB	White Perch	1980	4.82	0.66	1.20	23	8	
Mirex	White Perch	1980	0.24	0.04	0.07	20	8	-
PCB	White Perch	1984	2.82	2.82	0.0	1	100	1975, 1976, 197[illegible] 1978, 1979, 19[illegible] 1986

[1] Only parameters, species and years exceeding fish consumption guidelines are listed.
[2] Means are computed assuming values less than detection are equal to detection limit.
[3] Fish consumption guidelines are listed in Table A1.1, based on MOE (1984) and HWC (1987).

FIGURE 5.1
Annual Mean Mercury Concentrations
in Bay of Quinte Fish

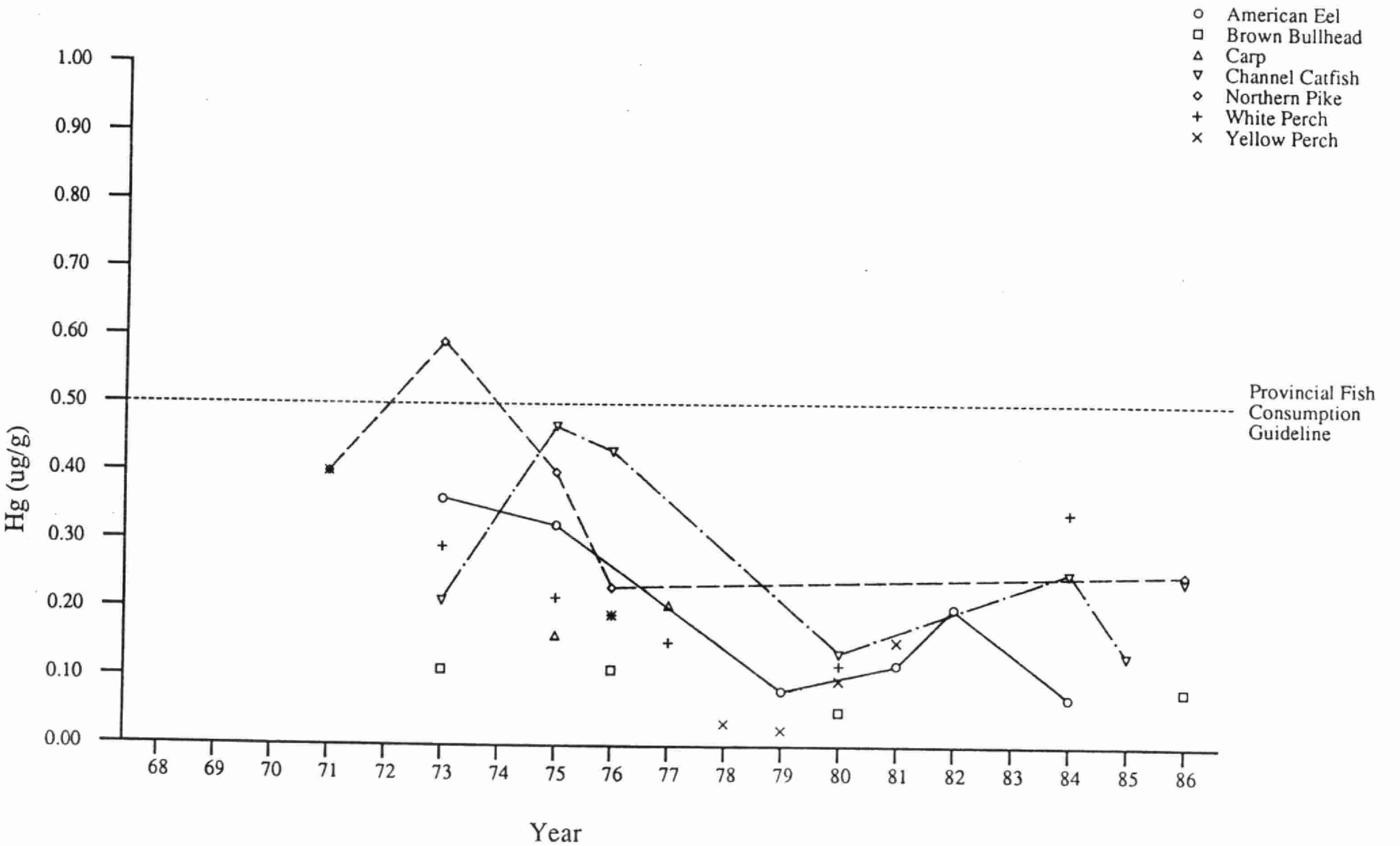

FIGURE 5.2
Annual Mean DDT Concentrations
in Bay of Quinte Fish

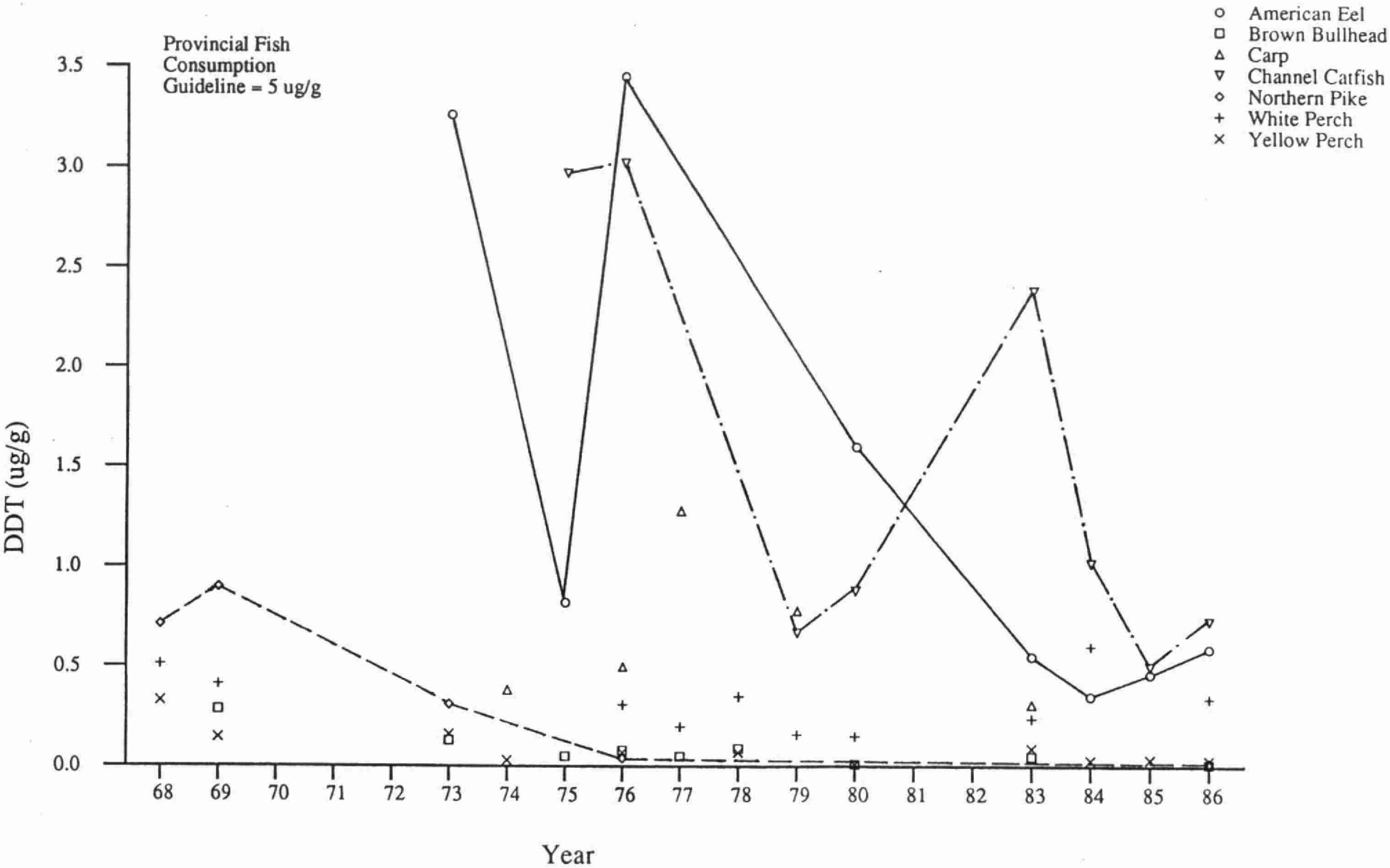

FIGURE 5.3
Annual Mean PCB Concentrations
in Bay of Quinte Fish

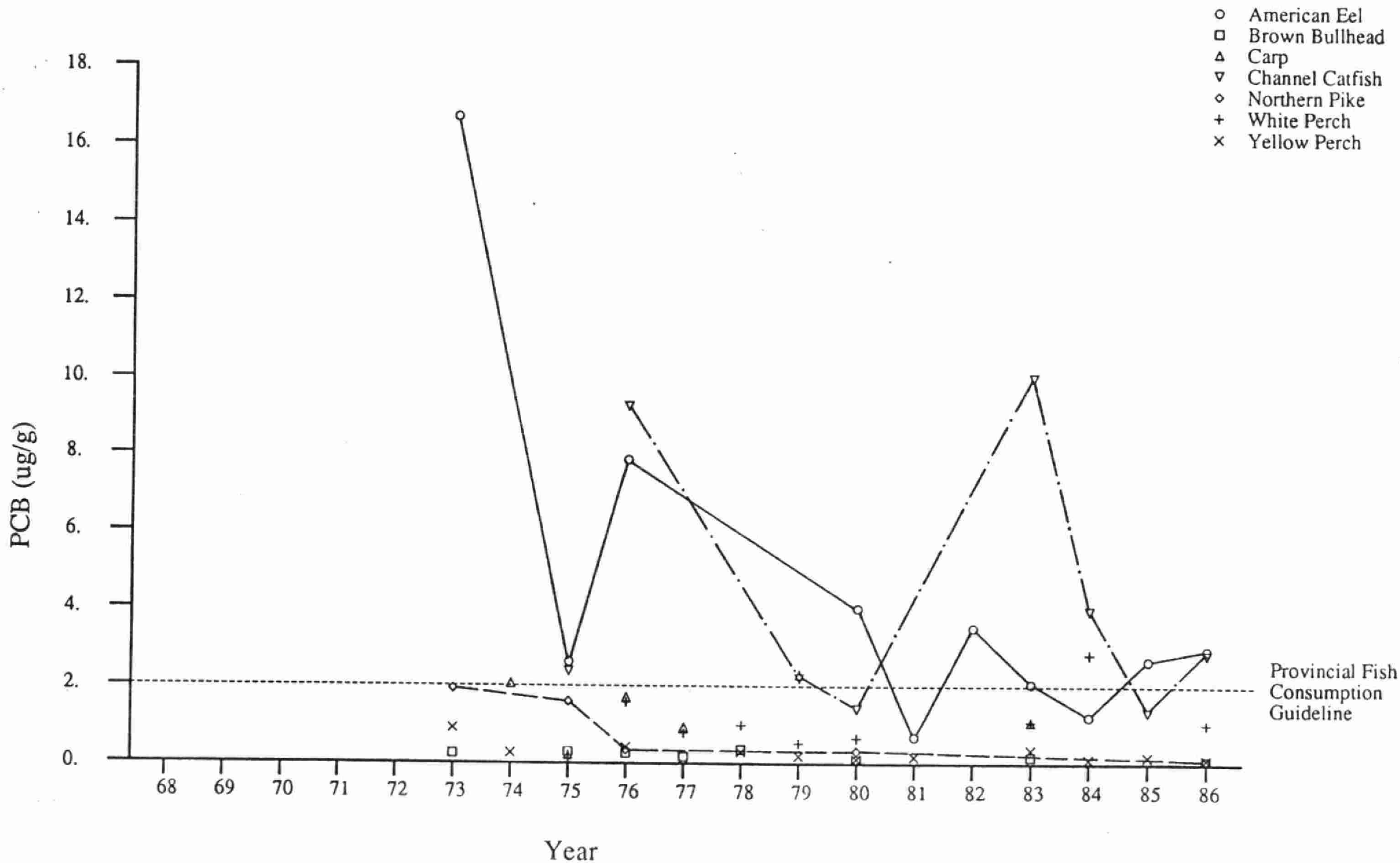

TABLE 6.1: LANDFILL SITES IN THE BAY OF QUINTE REGION

Site Name	Municipal Lot	Status	Type
Adolphustown Township	3704	C	M
Ameliasburg Township	3504	C	M
	3504 (71-72)	A	M
Belleville	3601	C	M
Deseronto	3712	A	M
	3712	C	M
Frankford	3625 (7)	A	M
Fredericksburg North Township	3710	C	M
Fredericksburg South Township	3710	A	M
	3710	A	T
Hallowell Township, Picton	3506	A	M
Murray Township	3125	-	-
Marysburg North Township	3508 (6)	C	M
	3508 (2)	A	T
Myers Pier, Belleville	-	C	M
Napanee	3701	C	M
Picton Marsh Creek	-	C	M
Quinte Landfill, Quinte Sanitation	3625 (17)	A	M
Richmond Township	3712	A	M
Sidney Township	3625 (3)	C	M
	3625 (13)	C	M
	3625 (18)	C	M
John A. Zebada	3625	A	M
Sophiasburg Township	3510	C	M
Thurlow Township	3626	C	M
	3626	A	M

TABLE 6.1: LANDFILL SITES IN THE BAY OF QUINTE REGION

Site Name	Municipal Lot	Status	Type
Trenton	3602	C	M
Tyendinaga Township	3628 (16) 3628 (33)	A C	M M
Zwick's Island Landfill Site	-	C	M

C = closed; A = open; M = municipal; T = transfer station.

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APPENDIX 1

Criteria for Evaluation of Water, Sediment and Fish Quality (Table A1.1) and Annual Mean Contaminant Concentrations Exceeding Water Quality Objectives in Bay of Quinte Tributaries (Table A1.2)

TABLE A1.1: CRITERIA FOR EVALUATION OF WATER, SEDIMENT AND FISH QUALITY

Chemical Parameter	Drinking Water (ug/L)		Aquatic Life (ug/L)		Fish Consumption (ug/g)		Dredge Disposal (ug/g)		Sediment Background (ug/g)
Cadmium	5	MOE	0.2	MOE			1	MOE	3.7
Chromium	50	MOE	100	MOE			25	MOE	86
Copper	1,000	MOE	5	MOE			25	MOE	100
Iron	300	MOE	300	MOE			10,000	MOE	53,000
Lead	50	MOE	25	MOE	1	MOE	50	MOE	32
Mercury	1	MOE	0.2	MOE	0.5	MOE	0.3	MOE	0.7
Arsenic	50	MOE	100	MOE			8	MOE	
Zinc	5,000	MOE	30	MOE			100	MOE	163
Nickel	1.34	EPA	25	MOE			25	MOE	48
Phenol	2	MOE	1	MOE					
Manganese	50	MOE							
Aluminum	200	WHO	100	IJC					
Cyanide	200	MOE	5	MOE			0.1	MOE	
PCB	3	MOE	0.001	MOE	2	MOE	0.05	MOE	0.078
Endosulfan I, II	74	EPA	0.003	MOE	0.1	HW	0.5		
Heptachlor (and HE)	0.00272	EPA	0.001	MOE	0.2	HW			
DDT	0.00024	EPA	0.003	MOE	5	MOE			
Toxaphene	5	MOE	0.008	MOE					
Pentachlorobenzene	74	EPA	50	EPA					
Hexachlorobenzene	0.0072	EPA	50	EPA					
Tetrachlorobenzene	38	EPA	50	EPA					
Mirex			0.001	MOE	0.1	MOE			
Aldrin (and Dieldrin)	0.7	MOE	0.001	MOE	0.2	HW			
Endrin	0.2	MOE	0.002	MOE	0.1	HW			
Lindane (γ-BHC)	4	MOE	0.01	MOE	0.2	HW			
Chlordane	7	MOE	0.06	MOE	0.1	HW			
Methoxychlor	100	MOE	0.04	MOE	0.1	HW			
Pentachlorophenol	10	WHO	0.4	IJC	3	HW			
Trichlorophenol (2,4,6)	10	WHO	970	EPA					
Tetrachlorophenol (2,3,4,6)	0.1	WHO							
Selenium	10	MOE	100	MOE					
Silver	50	MOE	0.1	MOE					

HW: Food and Drug Act Regulations, 1987.

MOE: Water Management Goals, Policies and Objectives, 1984 (Tables 1 and 4).

MOE: Persaud and Wilkins, 1975.

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Sediment Background: Mudroch et al. 1986. Pre-industrial horizons, Lake Ontario depositional areas.

TABLE A1.2: ANNUAL MEAN CONTAMINANT CONCENTRATIONS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Year of Exceedence	Concentration[2] (mg/L) Mean	S.D.	N	P	Objective(s)[3] Exceeded
Iron	17003500102	Napanee R. (5.633)	1973	0.383	0.192	12	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1973	0.079	0.027	10	0.80	DW, AL
Phenol	17003500102	Napanee R. (5.633)	1973	2.67	1.49	12	0.00	AL, DW
Copper	17003500102	Napanee R. (5.633)	1973	0.047	0.0064	10	0.90	AL
Zinc	17003500102	Napanee R. (5.633)	1973	0.045	0.019	10	0.50	AL
Iron	17003500102	Napanee R. (5.633)	1974	0.595	0.167	11	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1974	0.067	0.009	10	0.90	DW, AL
Phenol	17003500102	Napanee R. (5.633)	1974	2.64	2.15	11	0.27	DW, AL
Copper	17003500102	Napanee R. (5.633)	1974	0.099	0.131	10	0.80	AL
Zinc	17003500102	Napanee R. (5.633)	1974	0.088	0.075	10	0.60	AL
Iron	17003500102	Napanee R. (5.633)	1975	0.350	0.156	11	0.00	DW, AL
Cadmium	17003500102	Napanee R. (5.633)	1976	0.010	0.000	2	1.00	DW, AL
Iron	17003500102	Napanee R. (5.633)	1976	0.316	0.124	10	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1976	0.010	0.000	2	1.00	DW
Copper	17003500102	Napanee R. (5.633)	1976	0.090	0.010	2	0.00	AL
Zinc	17003500102	Napanee R. (5.633)	1976	0.060	0.050	2	0.50	AL
Lead	17003500102	Napanee R. (5.633)	1978	0.030	0.000	3	1.00	AL
Iron	17003500102	Napanee R. (5.633)	1981	0.450	0.184	8	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1981	0.002	0.0005	6	1.00	DW
Copper	17003500102	Napanee R. (5.633)	1981	0.006	0.006	6	0.00	AL
Iron	17003500102	Napanee R. (5.633)	1982	0.373	0.125	3	0.00	DW, AL
Copper	17003500102	Napanee R. (5.633)	1982	0.009	0.030	12	0.00	AL
Phenol	17003500102	Napanee R. (5.633)	1982	1.06	0.705	10	0.70	AL
Copper	17003500102	Napanee R. (5.633)	1984	0.008	0.017	12	0.00	AL
Copper	17003500102	Napanee R. (5.633)	1985	0.006	0.005	10	0.00	AL
Iron	17003500102	Napanee R. (5.633)	1986	0.380	0.204	7	0.00	DW, AL
Cadmium	17003500102	Napanee R. (5.633)	1986	0.0003	0.00007	7	1.00	AL
Iron	17003500102	Napanee R. (5.633)	1987	0.440	0.180	3	0.00	DW, AL
Cadmium	17003500102	Napanee R. (5.633)	1987	0.0005	0.0003	3	0.67	AL
Copper	17002600202	Moira R. (6.276)	1973	0.059	0.0287	11	0.91	AL
Nickel	17002600202	Moira R. (6.276)	1973	0.070	0.00002	11	1.00	DW, AL
Phenol	17002600202	Moira R. (6.276)	1973	2.50	1.85	12	0.00	DW, AL
Zinc	17002600202	Moira R. (6.276)	1973	0.049	0.026	11	0.45	AL
Nickel	17002600202	Moira R. (6.276)	1974	0.072	0.018	10	0.90	DW, AL
Copper	17002600202	Moira R. (6.276)	1974	0.063	0.046	10	0.90	AL
Phenol	17002600202	Moira R. (6.276)	1974	1.30	0.458	10	0.60	AL
Zinc	17002600202	Moira R. (6.276)	1974	0.045	0.012	10	0.80	AL
Nickel	17002600202	Moira R. (6.276)	1975	0.0467	0.025	6	0.83	DW, AL
Copper	17002600202	Moira R. (6.276)	1975	0.0417	0.023	6	0.67	AL
Zinc	17002600202	Moira R. (6.276)	1975	0.036	0.014	6	0.83	AL
Phenol	17002600202	Moira R. (6.276)	1976	1.20	0.400	5	0.60	AL
Cadmium	17002600202	Moira R. (6.276)	1982	0.0003	0.0002	12	0.83	AL
Copper	17002600202	Moira R. (6.276)	1982	0.009	0.010	12	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1983	0.0003	0.0002	10	0.70	AL
Copper	17002600202	Moira R. (6.276)	1983	0.011	0.008	12	0.00	AL
Mercury	17002600202	Moira R. (6.276)	1983	0.0005	0.0008	5	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1984	0.0005	0.0008	10	0.90	AL
Copper	17002600202	Moira R. (6.276)	1984	0.011	0.012	10	0.00	AL
Mercury	17002600202	Moira R. (6.276)	1984	0.0003	0.0002	8	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1985	0.0003	0.00005	9	1.00	AL
Copper	17002600202	Moira R. (6.276)	1985	0.006	0.005	10	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1986	0.0003	0.000	6	1.00	AL
Cadmium	17002600202	Moira R. (6.276)	1987	0.0003	0.000	2	1.00	AL
Cadmium	17002600102	Moira R. (1.127)	1976	0.010	0.000	2	1.00	DW, AL
Iron	17002600102	Moira R. (1.127)	1976	0.385	0.265	2	0.00	DW, AL
Nickel	17002600102	Moira R. (1.127)	1976	0.010	0.000	2	0.50	DW
Copper	17002600102	Moira R. (1.127)	1976	0.020	0.000	2	0.50	AL
Phenol	17002600102	Moira R. (1.127)	1976	2.00	0.000	1	0.00	AL
Arsenic	17002600102	Moira R. (1.127)	1977	0.053	0.152	18	0.00	DW
Nickel	17002600102	Moira R. (1.127)	1977	0.012	0.006	3	1.00	DW
Cadmium	17002600102	Moira R. (1.127)	1977	0.005	0.000	3	1.00	AL
Copper	17002600102	Moira R. (1.127)	1977	0.030	0.022	3	0.00	AL
Iron	17002600102	Moira R. (1.127)	1978	0.404	0.313	5	0.00	DW, AL
Nickel	17002600102	Moira R. (1.127)	1978	0.020	0.000	3	1.00	DW
Cadmium	17002600102	Moira R. (1.127)	1978	0.005	0.000	3	1.00	AL
Copper	17002600102	Moira R. (1.127)	1978	0.010	0.000	3	1.00	AL
Lead	17002600102	Moira R. (1.127)	1978	0.030	0.000	3	1.00	AL
Phenol	17002600102	Moira R. (1.127)	1978	1.25	0.433	4	0.25	AL
Cadmium	17002600102	Moira R. (1.127)	1979	0.005	0.0006	10	0.90	DW, AL
Nickel	17002600102	Moira R. (1.127)	1979	0.020	0.000	1	1.00	DW
Copper	17002600102	Moira R. (1.127)	1979	0.011	0.003	10	0.80	AL
PCB	17002600102	Moira R. (1.127)	1979	20	0.000	7	1.00	AL
Lead	17002600102	Moira R. (1.127)	1979	0.031	0.003	10	1.00	AL
PCB	17002600102	Moira R. (1.127)	1980	21.3	3.31	8	0.75	AL
Cadmium	17002600102	Moira R. (1.127)	1980	0.002	0.002	9	0.89	AL
Copper	17002600102	Moira R. (1.127)	1980	0.008	0.007	9	0.33	AL
Copper	17002600102	Moira R. (1.127)	1982	0.009	0.008	11	0.00	AL
Phenol	17002600102	Moira R. (1.127)	1982	1.10	0.659	10	0.50	AL

TABLE A1.2: ANNUAL MEAN CONTAMINANT CONCENTRATIONS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Year of Exceedence	Concentration[2] (mg/L)				Objective(s)[3] Exceeded
				Mean	S.D.	N	P	
Cadmium	17002600102	Moira R. (1.127)	1983	0.0003	0.0002	12	0.75	AL
Copper	17002600102	Moira R. (1.127)	1983	0.008	0.005	12	0.00	AL
Cadmium	17002600102	Moira R. (1.127)	1984	0.0002	0.00004	11	1.00	AL
Cadmium	17002600102	Moira R. (1.127)	1985	0.0003	0.00005	16	0.90	AL
Cadmium	17002600102	Moira R. (1.127)	1986	0.0003	0.000	8	1.00	AL
Iron	17002600102	Moira R. (1.127)	1987	0.350	0.000	1	0.00	DW, AL
Cadmium	17002600102	Moira R. (1.127)	1987	0.0003	0.000	1	1.00	AL
Cadmium	17002106883	Trent R. (0.805)	1976	0.009	0.002	4	1.00	DW, AL
Nickel	17002106883	Trent R. (0.805)	1976	0.010	0.000	4	1.00	DW
Copper	17002106883	Trent R. (0.805)	1976	0.142	0.207	4	0.50	AL
Phenol	17002106883	Trent R. (0.805)	1976	1.10	0.300	10	0.80	AL
Cadmium	17002106883	Trent R. (0.805)	1977	0.013	0.017	6	1.00	DW, AL
Nickel	17002106883	Trent R. (0.805)	1977	0.014	0.006	6	1.00	DW
Phenol	17002106883	Trent R. (0.805)	1977	2.28	1.93	9	0.44	DW, AL
Copper	17002106883	Trent R. (0.805)	1977	0.523	1.07	6	0.50	AL
Cadmium	17002106883	Trent R. (0.805)	1979	0.005	0.0003	22	0.91	DW, AL
Copper	17002106883	Trent R. (0.805)	1979	0.013	0.009	18	0.83	AL
PCB	17002106883	Trent R. (0.805)	1979	38	36	5	0.80	AL
Lead	17002106883	Trent R. (0.805)	1979	0.031	0.002	22	1.00	AL
Nickel	17002106883	Trent R. (0.805)	1980	0.020	0.000	2	1.00	DW
Cadmium	17002106883	Trent R. (0.805)	1980	0.003	0.002	61	0.98	AL
Copper	17002106883	Trent R. (0.805)	1980	0.006	0.004	45	0.62	AL
PCB	17002106883	Trent R. (0.805)	1980	20	0.000	8	0.88	AL
Nickel	17002104502	Trent R. (3.862)	1981	0.002	0.000	1	1.00	DW
Phenol	17002104502	Trent R. (3.862)	1981	1.25	0.433	4	0.50	AL
Nickel	17002106883	Trent R. (0.805)	1981	0.002	0.000	1	1.00	DW
Cadmium	17002106883	Trent R. (0.805)	1981	0.0003	0.0002	85	0.54	AL
Cadmium	17002106883	Trent R. (0.805)	1982	0.0003	0.0002	66	0.42	AL
Copper	17002106883	Trent R. (0.805)	1982	0.007	0.004	66	0.00	AL
PCB	17002106883	Trent R. (0.805)	1982	20.0	0.000	1	1.00	AL
Nickel	17002104502	Trent R. (3.862)	1983	0.003	0.002	5	0.60	DW
Cadmium	17002106883	Trent R. (0.805)	1983	0.0003	0.0002	89	0.56	AL
Copper	17002106883	Trent R. (0.805)	1983	0.007	0.004	90	0.00	AL
Nickel	17002104502	Trent R. (3.862)	1984	0.005	0.005	8	0.63	DW
Cadmium	17002106883	Trent R. (0.805)	1984	0.0002	0.00004	92	0.82	AL
PCB	17002106883	Trent R. (0.805)	1984	20	0.000	1	1.00	AL
Nickel	17002104502	Trent R. (3.862)	1985	0.002	0.001	7	0.57	DW
Nickel	17002106883	Trent R. (0.805)	1985	0.002	0.000	1	1.00	DW
Cadmium	17002106883	Trent R. (0.805)	1985	0.0002	0.00007	92	0.90	AL
PCB	17002106883	Trent R. (0.805)	1985	20	0.000	1	1.00	AL
Cadmium	17002104502	Trent R. (3.862)	1986	0.0003	0.000	7	1.00	AL
Phenol	17002104502	Trent R. (3.862)	1986	1.04	1.30	5	0.60	AL
Cadmium	17002106883	Trent R. (0.805)	1986	0.0002	0.00007	58	0.93	AL
PCB	17002106883	Trent R. (0.805)	1986	20	0.000	1	1.00	AL
Cadmium	17002104502	Trent R. (3.862)	1987	0.0003	0.000	1	1.00	AL
Cadmium	17002106883	Trent R. (0.805)	1987	0.0002	0.00005	6	0.83	AL
Cadmium	17003100102	Salmon R. (2.897)	1976	0.010	0.000	2	1.00	DW, AL
Nickel	17003100102	Salmon R. (2.897)	1976	0.010	0.000	2	1.00	DW
Phenol	17003100102	Salmon R. (2.897)	1977	1.18	0.386	11	0.64	AL
Nickel	17003100102	Salmon R. (2.897)	1978	0.020	0.000	3	1.00	DW
Phenol	17003100102	Salmon R. (2.897)	1982	1.06	0.705	10	0.70	AL
Cadmium	17003100102	Salmon R. (2.897)	1986	0.0003	0.00006	9	0.89	AL
Iron	17003100102	Salmon R. (2.897)	1987	0.313	0.085	3	0.00	DW, AL
Cadmium	17003100102	Salmon R. (2.897)	1987	0.0003	0.000	3	1.00	AL
Iron	17000800102	Picton Cr. (1.287)	1981	0.400	0.245	8	0.00	DW, AL
Nickel	17000800102	Picton Cr. (1.287)	1981	0.002	0.0005	9	0.56	DW
Copper	17000800102	Picton Cr. (1.287)	1981	0.009	0.009	9	0.00	AL
Iron	17000800102	Picton Cr. (1.287)	1982	0.317	0.265	11	0.00	DW, AL
Nickel	17000800102	Picton Cr. (1.287)	1982	0.002	0.001	11	0.82	DW
Copper	17000800102	Picton Cr. (1.287)	1982	0.006	0.007	11	0.00	AL
Iron	17000800102	Picton Cr. (1.287)	1983	0.392	0.226	11	0.00	DW, AL
Nickel	17000800102	Picton Cr. (1.287)	1983	0.091	0.272	11	0.64	DW, AL
Lead	17000800102	Picton Cr. (1.287)	1983	0.067	0.200	11	0.73	DW, AL
Copper	17000800102	Picton Cr. (1.287)	1983	0.031	0.079	11	0.09	AL
Nickel	17000800102	Picton Cr. (1.287)	1984	0.042	0.112	9	0.67	DW, AL
Lead	17000800102	Picton Cr. (1.287)	1984	0.114	0.313	9	0.89	DW, AL
Copper	17000800102	Picton Cr. (1.287)	1984	0.040	0.099	9	0.00	AL
Zinc	17000800102	Picton Cr. (1.287)	1984	2.12	5.97	9	0.00	AL
Nickel	17000800102	Picton Cr. (1.287)	1985	0.002	0.000	11	1.00	DW
Phenol	17000800102	Picton Cr. (1.287)	1985	1.84	5.06	10	0.60	AL
Nickel	17000800102	Picton Cr. (1.287)	1986	0.002	0.000	1	1.00	DW
Cadmium	17000800102	Picton Cr. (1.287)	1986	0.002	0.001	6	0.83	AL
Copper	17000800102	Picton Cr. (1.287)	1986	0.006	0.003	7	0.14	AL
Zinc	17000800102	Picton Cr. (1.287)	1986	0.031	0.061	7	0.14	AL
Iron	17001400102	Demorestville Cr. (4.828)	1981	0.444	0.355	8	0.00	DW, AL
Nickel	17001400102	Demorestville Cr. (4.828)	1981	0.002	0.0005	10	0.70	DW
Copper	17001400102	Demorestville Cr. (4.828)	1981	0.006	0.009	10	0.10	AL
Iron	17001400102	Demorestville Cr. (4.828)	1982	0.357	0.394	11	0.00	DW
Nickel	17001400102	Demorestville Cr. (4.828)	1982	0.003	0.006	11	0.82	DW, AL

TABLE A1.2: ANNUAL MEAN CONTAMINANT CONCENTRATIONS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Year of Exceedence	Concentration[2] (mg/L)				Objective(s)[3] Exceeded
				Mean	S.D.	N	P	
Copper	17001400102	Demorestville Cr. (4.828)	1982	0.006	0.003	11	0.00	AL
Phenol	17001400102	Demorestville Cr. (4.828)	1982	1.58	1.98	10	0.60	AL
Nickel	17001400102	Demorestville Cr. (4.828)	1983	0.002	0.0007	10	0.80	DW
Copper	17001400102	Demorestville Cr. (4.828)	1983	0.005	0.008	10	0.10	AL
Iron	17001400102	Demorestville Cr. (4.828)	1985	0.491	0.986	11	0.00	DW, AL
Nickel	17001400102	Demorestville Cr. (4.828)	1985	0.002	0.0004	11	0.91	DW
Phenol	17001400102	Demorestville Cr. (4.828)	1985	1.32	1.21	8	0.50	AL
Nickel	17001400102	Demorestville Cr. (4.828)	1986	0.002	0.000	1	1.00	DW
Cadmium	17001400102	Demorestville Cr. (4.828)	1986	0.0003	0.000	6	1.00	AL
Iron	17001400102	Demorestville Cr. (4.828)	1987	1.70	1.60	2	0.00	DW, AL
Cadmium	17001400102	Demorestville Cr. (4.828)	1987	0.002	0.001	2	1.00	AL
Iron	17001600102	Sawguin R. (8.851)	1981	0.894	0.760	8	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1981	0.002	0.0005	10	0.80	DW
Iron	17001600102	Sawguin R. (8.851)	1982	1.07	1.42	11	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1982	0.002	0.0009	11	0.55	DW
Phenol	17001600102	Sawguin R. (8.851)	1982	4.76	8.14	10	0.60	DW, AL
Iron	17001600102	Sawguin R. (8.851)	1983	0.360	0.198	11	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1983	0.002	0.0004	10	1.00	DW
Copper	17001600102	Sawguin R. (8.851)	1983	0.007	0.008	10	0.00	AL
Iron	17001600102	Sawguin R. (8.851)	1984	0.370	0.222	10	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1984	0.002	0.0003	11	0.91	DW
Copper	17001600102	Sawguin R. (8.851)	1984	0.012	0.028	11	0.00	AL
Iron	17001600102	Sawguin R. (8.851)	1985	0.846	1.92	11	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1985	0.002	0.0008	11	0.91	DW
Phenol	17001600102	Sawguin R. (8.851)	1985	6.89	16.7	9	0.56	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1986	0.002	0.000	1	1.00	DW
Cadmium	17001600102	Sawguin R. (8.851)	1986	0.0003	0.000	6	1.00	AL
Iron	17001600102	Sawguin R. (8.851)	1987	6.100	0.0005	1	0.00	DW, AL
Cadmium	17001600102	Sawguin R. (8.851)	1987	0.003	0.000	1	1.00	AL
Lead	17001600102	Sawguin R. (8.851)	1987	0.030	0.000	1	1.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1981	0.017	0.015	11	0.09	AL
Copper	6018000402	Millhaven Cr. (6.437)	1982	0.006	0.004	12	0.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1983	0.011	0.008	11	0.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1984	0.007	0.013	12	0.00	AL
Cadmium	6018000402	Millhaven Cr. (6.437)	1986	0.0003	0.000	7	1.00	AL
Cadmium	6018000402	Millhaven Cr. (6.437)	1987	0.012	0.015	4	0.00	AL
Zinc	6018000402	Millhaven Cr. (6.437)	1987	0.034	0.022	4	0.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1987	0.0115	0.0153	4	0.00	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1984	1.43	2.4	9	0.00	DW, AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1984	0.009	0.009	9	0.00	AL
Zinc	17000800202	Picton Marsh Cr. (0.000)	1984	0.031	0.042	9	0.00	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1985	0.540	0.323	10	0.00	DW, AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1985	0.005	0.004	10	0.10	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1986	0.670	0.340	6	0.00	DW, AL
Cadmium	17000800202	Picton Marsh Cr. (0.000)	1986	0.0014	0.0013	5	1.00	AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1986	0.008	0.008	6	0.00	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1987	0.945	0.255	2	0.00	DW, AL
Cadmium	17000800202	Picton Marsh Cr. (0.000)	1987	0.002	0.001	2	1.00	AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1987	0.005	0.0025	2	0.00	AL

[1] Only parameters and years exceeding objectives are listed.

[2] Means are computed assuming trace values (with T flags) are as reported and values less than detection limit (W flags) are equal to the detection limit. P is proportion of observations (N) with T or W flags. Phenol and PCB in ug/L.

[3] Water quality objectives for drinking water (DW) and protection of aquatic life (AL) are listed in Table A1.1, based on MOE (1984a), WHO (1984), IJC (1978, 1980, 1981, 1983a, 1985) and U.S. EPA (1976, 1980).

TABLE A1.2: ANNUAL MEAN CONTAMINANT CONCENTRATIONS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Year of Exceedence	Concentration[2] (mg/L)				Objective(s) Exceeded[3]
				Mean	S.D.	N	P	
Copper	17001400102	Demorestville Cr. (4.828)	1982	0.006	0.003	11	0.00	AL
Phenol	17001400102	Demorestville Cr. (4.828)	1982	1.58	1.98	10	0.60	AL
Nickel	17001400102	Demorestville Cr. (4.828)	1983	0.002	0.0007	10	0.80	DW
Copper	17001400102	Demorestville Cr. (4.828)	1983	0.005	0.008	10	0.10	AL
Iron	17001400102	Demorestville Cr. (4.828)	1985	0.491	0.986	11	0.00	DW, AL
Nickel	17001400102	Demorestville Cr. (4.828)	1985	0.002	0.0004	11	0.91	DW
Phenol	17001400102	Demorestville Cr. (4.828)	1985	1.32	1.21	8	0.50	AL
Nickel	17001400102	Demorestville Cr. (4.828)	1986	0.002	0.000	1	1.00	DW
Cadmium	17001400102	Demorestville Cr. (4.828)	1986	0.0003	0.000	6	1.00	AL
Iron	17001400102	Demorestville Cr. (4.828)	1987	1.70	1.60	2	0.00	DW, AL
Cadmium	17001400102	Demorestville Cr. (4.828)	1987	0.002	0.001	2	1.00	AL
Iron	17001600102	Sawguin R. (8.851)	1981	0.894	0.760	8	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1981	0.002	0.0005	10	0.80	DW
Iron	17001600102	Sawguin R. (8.851)	1982	1.07	1.42	11	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1982	0.002	0.0009	11	0.55	DW
Phenol	17001600102	Sawguin R. (8.851)	1982	4.76	8.14	10	0.60	DW, AL
Iron	17001600102	Sawguin R. (8.851)	1983	0.360	0.198	11	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1983	0.002	0.0004	10	1.00	DW
Copper	17001600102	Sawguin R. (8.851)	1983	0.007	0.008	10	0.00	AL
Iron	17001600102	Sawguin R. (8.851)	1984	0.370	0.222	10	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1984	0.002	0.0003	11	0.91	DW
Copper	17001600102	Sawguin R. (8.851)	1984	0.012	0.028	11	0.00	AL
Iron	17001600102	Sawguin R. (8.851)	1985	0.846	1.92	11	0.00	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1985	0.002	0.0008	11	0.91	DW
Phenol	17001600102	Sawguin R. (8.851)	1985	6.89	16.7	9	0.56	DW, AL
Nickel	17001600102	Sawguin R. (8.851)	1986	0.002	0.000	1	1.00	DW
Cadmium	17001600102	Sawguin R. (8.851)	1986	0.0003	0.000	6	1.00	AL
Iron	17001600102	Sawguin R. (8.851)	1987	6.100	0.0005	1	0.00	DW, AL
Cadmium	17001600102	Sawguin R. (8.851)	1987	0.003	0.000	1	1.00	AL
Lead	17001600102	Sawguin R. (8.851)	1987	0.030	0.000	1	1.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1981	0.017	0.015	11	0.09	AL
Copper	6018000402	Millhaven Cr. (6.437)	1982	0.006	0.004	12	0.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1983	0.011	0.008	11	0.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1984	0.007	0.013	12	0.00	AL
Cadmium	6018000402	Millhaven Cr. (6.437)	1986	0.0003	0.000	7	1.00	AL
Cadmium	6018000402	Millhaven Cr. (6.437)	1987	0.012	0.015	4	0.00	AL
Zinc	6018000402	Millhaven Cr. (6.437)	1987	0.034	0.022	4	0.00	AL
Copper	6018000402	Millhaven Cr. (6.437)	1987	0.0115	0.0153	4	0.00	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1984	1.43	2.4	9	0.00	DW, AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1984	0.009	0.009	9	0.00	AL
Zinc	17000800202	Picton Marsh Cr. (0.000)	1984	0.031	0.042	9	0.00	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1985	0.540	0.323	10	0.00	DW, AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1985	0.005	0.004	10	0.10	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1986	0.670	0.340	6	0.00	DW, AL
Cadmium	17000800202	Picton Marsh Cr. (0.000)	1986	0.0014	0.0013	5	1.00	AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1986	0.008	0.008	6	0.00	AL
Iron	17000800202	Picton Marsh Cr. (0.000)	1987	0.945	0.255	2	0.00	DW, AL
Cadmium	17000800202	Picton Marsh Cr. (0.000)	1987	0.002	0.001	2	1.00	AL
Copper	17000800202	Picton Marsh Cr. (0.000)	1987	0.005	0.0025	2	0.00	AL

1 Only parameters and years exceeding objectives are listed.

2 Means are computed assuming trace values (with T flags) are as reported and values less than detection limit (W flags) are equal to the detection limit. P is proportion of observations (N) with T or W flags. Phenol in ug/L and PCB in ng/L.

3 Water quality objectives for drinking water (DW) and protection of aquatic life (AL) are listed in Table A1.1, based on MOE (1984a), WHO (1984), IJC (1978, 1980, 1981, 1983a, 1985) and U.S. EPA (1976, 1980).

TABLE A1.1: CRITERIA FOR EVALUATION OF WATER, SEDIMENT AND FISH QUALITY

Chemical Parameter	Drinking Water (ug/L)		Aquatic Life (ug/L)		Fish Consumption (ug/g)		Dredge Disposal (ug/g)		Sediment Background (ug/g)
Cadmium	5	MOE	0.2	MOE			1	MOE	3.7
Chromium	50	MOE	100	MOE			25	MOE	86
Copper	1,000	MOE	5	MOE			25	MOE	100
Iron	300	MOE	300	MOE			10,000	MOE	53,000
Lead	50	MOE	25	MOE	1	MOE	50	MOE	32
Mercury	1	MOE	0.2	MOE	0.5	MOE	0.3	MOE	0.7
Arsenic	50	MOE	100	MOE			8	MOE	
Zinc	5,000	MOE	30	MOE			100	MOE	163
Nickel	1.34	EPA	25	MOE			25	MOE	48
Phenol	2	MOE	1	MOE					
Manganese	50	MOE							
Aluminum	200	WHO	100	IJC					
Cyanide	200	MOE	5	MOE			0.1	MOE	
PCB	3	MOE	0.001	MOE	2	MOE	0.05	MOE	0.078
Endosulfan I, II	74	EPA	0.003	MOE	0.1	HW	0.5		
Heptachlor (and HE)	0.00272	EPA	0.001	MOE	0.2	HW			
DDT	0.00024	EPA	0.003	MOE	5	MOE			
Toxaphene	5	MOE	0.008	MOE					
Pentachlorobenzene	74	EPA	50	EPA					
Hexachlorobenzene	0.0072	EPA	50	EPA					
Tetrachlorobenzene	38	EPA	50	EPA					
Mirex			0.001	MOE	0.1	MOE			
Aldrin (and Dieldrin)	0.7	MOE	0.001	MOE	0.2	HW			
Endrin	0.2	MOE	0.002	MOE	0.1	HW			
Lindane (γ-BHC)	4	MOE	0.01	MOE	0.2	HW			
Chlordane	7	MOE	0.06	MOE	0.1	HW			
Methoxychlor	100	MOE	0.04	MOE	0.1	HW			
Pentachlorophenol	10	WHO	0.4	IJC	3	HW			
Trichlorophenol (2,4,6)	10	WHO	970	EPA					
Tetrachlorophenol (2,3,4,6)	0.1	WHO							
Selenium	10	MOE	100	MOE					
Silver	50	MOE	0.1	MOE					

HW: Food and Drug Act Regulations, 1987.

MOE: Water Management Goals, Policies and Objectives, 1984 (Tables 1 and 4).

MOE: Persaud and Wilkins, 1975.

WHO: Guidelines for Drinking Water Quality, Vol. 2. 1984.

IJC: Great Lakes Water Quality Agreement. 1978; Reports of the Aquatic Ecosystem Objectives Committee. 1980, 1981, 1983a, 1985.

EPA: Water Quality Criteria Documents. Federal Register 45: 99318. 1980. Quality Criteria for Water. 1976.

Sediment Background: Mudroch et al. 1986. Pre-industrial horizons, Lake Ontario depositional areas.

TABLE A1.2: ANNUAL MEAN CONTAMINANT CONCENTRATIONS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Year of Exceedence	Concentration[2] (mg/L) Mean	S.D.	N	P	Objective(s)[3] Exceeded
Iron	17003500102	Napanee R. (5.633)	1973	0.383	0.192	12	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1973	0.079	0.027	10	0.80	DW, AL
Phenol	17003500102	Napanee R. (5.633)	1973	2.67	1.49	12	0.00	AL, DW
Copper	17003500102	Napanee R. (5.633)	1973	0.047	0.0064	10	0.90	AL
Zinc	17003500102	Napanee R. (5.633)	1973	0.045	0.019	10	0.50	AL
Iron	17003500102	Napanee R. (5.633)	1974	0.595	0.167	11	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1974	0.067	0.009	10	0.90	DW, AL
Phenol	17003500102	Napanee R. (5.633)	1974	2.64	2.15	11	0.27	DW, AL
Copper	17003500102	Napanee R. (5.633)	1974	0.099	0.131	10	0.80	AL
Zinc	17003500102	Napanee R. (5.633)	1974	0.088	0.075	10	0.60	AL
Iron	17003500102	Napanee R. (5.633)	1975	0.350	0.156	11	0.00	DW, AL
Cadmium	17003500102	Napanee R. (5.633)	1976	0.010	0.000	2	1.00	DW, AL
Iron	17003500102	Napanee R. (5.633)	1976	0.316	0.124	10	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1976	0.010	0.000	2	1.00	DW
Copper	17003500102	Napanee R. (5.633)	1976	0.090	0.010	2	0.00	AL
Zinc	17003500102	Napanee R. (5.633)	1976	0.060	0.050	2	0.50	AL
Lead	17003500102	Napanee R. (5.633)	1978	0.030	0.000	3	1.00	AL
Iron	17003500102	Napanee R. (5.633)	1981	0.450	0.184	8	0.00	DW, AL
Nickel	17003500102	Napanee R. (5.633)	1981	0.002	0.0005	6	1.00	DW
Copper	17003500102	Napanee R. (5.633)	1981	0.006	0.006	6	0.00	AL
Iron	17003500102	Napanee R. (5.633)	1982	0.373	0.125	3	0.00	DW, AL
Copper	17003500102	Napanee R. (5.633)	1982	0.009	0.030	12	0.00	AL
Phenol	17003500102	Napanee R. (5.633)	1982	1.06	0.705	10	0.70	AL
Copper	17003500102	Napanee R. (5.633)	1984	0.008	0.017	12	0.00	AL
Copper	17003500102	Napanee R. (5.633)	1985	0.006	0.005	10	0.00	AL
Iron	17003500102	Napanee R. (5.633)	1986	0.380	0.204	7	0.00	DW, AL
Cadmium	17003500102	Napanee R. (5.633)	1986	0.0003	0.00007	7	1.00	AL
Iron	17003500102	Napanee R. (5.633)	1987	0.440	0.180	3	0.00	DW, AL
Cadmium	17003500102	Napanee R. (5.633)	1987	0.0005	0.0003	3	0.67	AL
Copper	17002600202	Moira R. (6.276)	1973	0.059	0.0287	11	0.91	AL
Nickel	17002600202	Moira R. (6.276)	1973	0.070	0.00002	11	1.00	DW, AL
Phenol	17002600202	Moira R. (6.276)	1973	2.50	1.85	12	0.00	DW, AL
Zinc	17002600202	Moira R. (6.276)	1973	0.049	0.026	11	0.45	AL
Nickel	17002600202	Moira R. (6.276)	1974	0.072	0.018	10	0.90	DW, AL
Copper	17002600202	Moira R. (6.276)	1974	0.063	0.046	10	0.90	AL
Phenol	17002600202	Moira R. (6.276)	1974	1.30	0.458	10	0.60	AL
Zinc	17002600202	Moira R. (6.276)	1974	0.045	0.012	10	0.80	AL
Nickel	17002600202	Moira R. (6.276)	1975	0.0467	0.025	6	0.83	DW, AL
Copper	17002600202	Moira R. (6.276)	1975	0.0417	0.023	6	0.67	AL
Zinc	17002600202	Moira R. (6.276)	1975	0.036	0.014	6	0.83	AL
Phenol	17002600202	Moira R. (6.276)	1976	1.20	0.400	5	0.60	AL
Cadmium	17002600202	Moira R. (6.276)	1982	0.0003	0.0002	12	0.83	AL
Copper	17002600202	Moira R. (6.276)	1982	0.009	0.010	12	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1983	0.0003	0.0002	10	0.70	AL
Copper	17002600202	Moira R. (6.276)	1983	0.011	0.008	12	0.00	AL
Mercury	17002600202	Moira R. (6.276)	1983	0.0005	0.0008	5	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1984	0.0005	0.0008	10	0.90	AL
Copper	17002600202	Moira R. (6.276)	1984	0.011	0.012	10	0.00	AL
Mercury	17002600202	Moira R. (6.276)	1984	0.0003	0.0002	8	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1985	0.0003	0.00005	9	1.00	AL
Copper	17002600202	Moira R. (6.276)	1985	0.006	0.005	10	0.00	AL
Cadmium	17002600202	Moira R. (6.276)	1986	0.0003	0.000	6	1.00	AL
Cadmium	17002600202	Moira R. (6.276)	1987	0.0003	0.000	2	1.00	AL
Cadmium	17002600102	Moira R. (1.127)	1976	0.010	0.000	2	1.00	DW, AL
Iron	17002600102	Moira R. (1.127)	1976	0.385	0.265	2	0.00	DW, AL
Nickel	17002600102	Moira R. (1.127)	1976	0.010	0.000	2	0.50	DW
Copper	17002600102	Moira R. (1.127)	1976	0.020	0.000	2	0.50	AL
Phenol	17002600102	Moira R. (1.127)	1976	2.00	0.000	1	0.00	AL
Arsenic	17002600102	Moira R. (1.127)	1977	0.053	0.152	18	0.00	DW
Nickel	17002600102	Moira R. (1.127)	1977	0.012	0.006	3	1.00	DW
Cadmium	17002600102	Moira R. (1.127)	1977	0.005	0.000	3	1.00	AL
Copper	17002600102	Moira R. (1.127)	1977	0.030	0.022	3	0.00	AL
Iron	17002600102	Moira R. (1.127)	1978	0.404	0.313	5	0.00	DW, AL
Nickel	17002600102	Moira R. (1.127)	1978	0.020	0.000	3	1.00	DW
Cadmium	17002600102	Moira R. (1.127)	1978	0.005	0.000	3	1.00	AL
Copper	17002600102	Moira R. (1.127)	1978	0.010	0.000	3	1.00	AL
Lead	17002600102	Moira R. (1.127)	1978	0.030	0.000	3	1.00	AL
Phenol	17002600102	Moira R. (1.127)	1978	1.25	0.433	4	0.25	AL
Cadmium	17002600102	Moira R. (1.127)	1979	0.005	0.0006	10	0.90	DW, AL
Nickel	17002600102	Moira R. (1.127)	1979	0.020	0.000	1	1.00	DW
Copper	17002600102	Moira R. (1.127)	1979	0.011	0.003	10	0.80	AL
PCB	17002600102	Moira R. (1.127)	1979	20	0.000	7	1.00	AL
Lead	17002600102	Moira R. (1.127)	1979	0.031	0.003	10	1.00	AL
PCB	17002600102	Moira R. (1.127)	1980	21.3	3.31	8	0.75	AL
Cadmium	17002600102	Moira R. (1.127)	1980	0.002	0.002	9	0.89	AL
Copper	17002600102	Moira R. (1.127)	1980	0.008	0.007	9	0.33	AL
Copper	17002600102	Moira R. (1.127)	1982	0.009	0.008	11	0.00	AL
Phenol	17002600102	Moira R. (1.127)	1982	1.10	0.659	10	0.50	AL

TABLE A1.2: ANNUAL MEAN CONTAMINANT CONCENTRATIONS EXCEEDING WATER QUALITY OBJECTIVES IN BAY OF QUINTE TRIBUTARIES (MOE, 1973-1987)

Chemical Parameter[1]	MOE Tributary Monitoring Station	Location (km from mouth)	Year of Exceedence	Concentration[2] (mg/L)				Objective(s)[3] Exceeded
				Mean	S.D.	N	P	
Cadmium	17002600102	Moira R. (1.127)	1983	0.0003	0.0002	12	0.75	AL
Copper	17002600102	Moira R. (1.127)	1983	0.008	0.005	12	0.00	AL
Cadmium	17002600102	Moira R. (1.127)	1984	0.0002	0.00004	11	1.00	AL
Cadmium	17002600102	Moira R. (1.127)	1985	0.0003	0.00005	16	0.90	AL
Cadmium	17002600102	Moira R. (1.127)	1986	0.0003	0.000	8	1.00	AL
Iron	17002600102	Moira R. (1.127)	1987	0.350	0.000	1	0.00	DW, AL
Cadmium	17002600102	Moira R. (1.127)	1987	0.0003	0.000	1	1.00	AL
Cadmium	17002106883	Trent R. (0.805)	1976	0.009	0.002	4	1.00	DW, AL
Nickel	17002106883	Trent R. (0.805)	1976	0.010	0.000	4	1.00	DW
Copper	17002106883	Trent R. (0.805)	1976	0.142	0.207	4	0.50	AL
Phenol	17002106883	Trent R. (0.805)	1976	1.10	0.300	10	0.80	AL
Cadmium	17002106883	Trent R. (0.805)	1977	0.013	0.017	6	1.00	DW, AL
Nickel	17002106883	Trent R. (0.805)	1977	0.014	0.006	6	1.00	DW
Phenol	17002106883	Trent R. (0.805)	1977	2.28	1.93	9	0.44	DW, AL
Copper	17002106883	Trent R. (0.805)	1977	0.523	1.07	6	0.50	AL
Cadmium	17002106883	Trent R. (0.805)	1979	0.005	0.0003	22	0.91	DW, AL
Copper	17002106883	Trent R. (0.805)	1979	0.013	0.009	18	0.83	AL
PCB	17002106883	Trent R. (0.805)	1979	38	36	5	0.80	AL
Lead	17002106883	Trent R. (0.805)	1979	0.031	0.002	22	1.00	AL
Nickel	17002106883	Trent R. (0.805)	1980	0.020	0.000	2	1.00	DW
Cadmium	17002106883	Trent R. (0.805)	1980	0.003	0.002	61	0.98	AL
Copper	17002106883	Trent R. (0.805)	1980	0.006	0.004	45	0.62	AL
PCB	17002106883	Trent R. (0.805)	1980	20	0.000	8	0.88	AL
Nickel	17002104502	Trent R. (3.862)	1981	0.002	0.000	1	1.00	DW
Phenol	17002104502	Trent R. (3.862)	1981	1.25	0.433	4	0.50	AL
Nickel	17002106883	Trent R. (0.805)	1981	0.002	0.000	1	1.00	DW
Cadmium	17002106883	Trent R. (0.805)	1981	0.0003	0.0002	85	0.54	AL
Cadmium	17002106883	Trent R. (0.805)	1982	0.0003	0.0002	66	0.42	AL
Copper	17002106883	Trent R. (0.805)	1982	0.007	0.004	66	0.00	AL
PCB	17002106883	Trent R. (0.805)	1982	20.0	0.000	1	1.00	AL
Nickel	17002104502	Trent R. (3.862)	1983	0.003	0.002	5	0.60	DW
Cadmium	17002106883	Trent R. (0.805)	1983	0.0003	0.0002	89	0.56	AL
Copper	17002106883	Trent R. (0.805)	1983	0.007	0.004	90	0.00	AL
Nickel	17002104502	Trent R. (3.862)	1984	0.005	0.005	8	0.63	DW
Cadmium	17002106883	Trent R. (0.805)	1984	0.0002	0.00004	92	0.82	AL
PCB	17002106883	Trent R. (0.805)	1984	20	0.000	1	1.00	AL
Nickel	17002104502	Trent R. (3.862)	1985	0.002	0.001	7	0.57	DW
Nickel	17002106883	Trent R. (0.805)	1985	0.002	0.000	1	1.00	DW
Cadmium	17002106883	Trent R. (0.805)	1985	0.0002	0.00007	92	0.90	AL
PCB	17002106883	Trent R. (0.805)	1985	20	0.000	1	1.00	AL
Cadmium	17002104502	Trent R. (3.862)	1986	0.0003	0.000	7	1.00	AL
Phenol	17002104502	Trent R. (3.862)	1986	1.04	1.30	5	0.60	AL
Cadmium	17002106883	Trent R. (0.805)	1986	0.0002	0.00007	58	0.93	AL
PCB	17002106883	Trent R. (0.805)	1986	20	0.000	1	1.00	AL
Cadmium	17002104502	Trent R. (3.862)	1987	0.0003	0.000	1	1.00	AL
Cadmium	17002106883	Trent R. (0.805)	1987	0.0002	0.00005	6	0.83	AL
Cadmium	17003100102	Salmon R. (2.897)	1976	0.010	0.000	2	1.00	DW, AL
Nickel	17003100102	Salmon R. (2.897)	1976	0.010	0.000	2	1.00	DW
Phenol	17003100102	Salmon R. (2.897)	1977	1.18	0.386	11	0.64	AL
Nickel	17003100102	Salmon R. (2.897)	1978	0.020	0.000	3	1.00	DW
Phenol	17003100102	Salmon R. (2.897)	1982	1.06	0.705	10	0.70	AL
Cadmium	17003100102	Salmon R. (2.897)	1986	0.0003	0.00006	9	0.89	AL
Iron	17003100102	Salmon R. (2.897)	1987	0.313	0.085	3	0.00	DW, AL
Cadmium	17003100102	Salmon R. (2.897)	1987	0.0003	0.000	3	1.00	AL
Iron	17000800102	Picton Cr. (1.287)	1981	0.400	0.245	8	0.00	DW, AL
Nickel	17000800102	Picton Cr. (1.287)	1981	0.002	0.0005	9	0.56	DW
Copper	17000800102	Picton Cr. (1.287)	1981	0.009	0.009	9	0.00	AL
Iron	17000800102	Picton Cr. (1.287)	1982	0.317	0.265	11	0.00	DW, AL
Nickel	17000800102	Picton Cr. (1.287)	1982	0.002	0.001	11	0.82	DW
Copper	17000800102	Picton Cr. (1.287)	1982	0.006	0.007	11	0.00	AL
Iron	17000800102	Picton Cr. (1.287)	1983	0.392	0.226	11	0.00	DW, AL
Nickel	17000800102	Picton Cr. (1.287)	1983	0.091	0.272	11	0.64	DW, AL
Lead	17000800102	Picton Cr. (1.287)	1983	0.067	0.200	11	0.73	DW, AL
Copper	17000800102	Picton Cr. (1.287)	1983	0.031	0.079	11	0.09	AL
Nickel	17000800102	Picton Cr. (1.287)	1984	0.042	0.112	9	0.67	DW, AL
Lead	17000800102	Picton Cr. (1.287)	1984	0.114	0.313	9	0.89	DW, AL
Copper	17000800102	Picton Cr. (1.287)	1984	0.040	0.099	9	0.00	AL
Zinc	17000800102	Picton Cr. (1.287)	1984	2.12	5.97	9	0.00	AL
Nickel	17000800102	Picton Cr. (1.287)	1985	0.002	0.000	11	1.00	DW
Phenol	17000800102	Picton Cr. (1.287)	1985	1.84	5.06	10	0.60	AL
Nickel	17000800102	Picton Cr. (1.287)	1986	0.002	0.000	1	1.00	DW
Cadmium	17000800102	Picton Cr. (1.287)	1986	0.002	0.001	6	0.83	AL
Copper	17000800102	Picton Cr. (1.287)	1986	0.006	0.003	7	0.14	AL
Zinc	17000800102	Picton Cr. (1.287)	1986	0.031	0.061	7	0.14	AL
Iron	17001400102	Demorestville Cr. (4.828)	1981	0.444	0.355	8	0.00	DW, AL
Nickel	17001400102	Demorestville Cr. (4.828)	1981	0.002	0.0005	10	0.70	DW
Copper	17001400102	Demorestville Cr. (4.828)	1981	0.006	0.009	10	0.10	AL
Iron	17001400102	Demorestville Cr. (4.828)	1982	0.357	0.394	11	0.00	DW
Nickel	17001400102	Demorestville Cr. (4.828)	1982	0.003	0.006	11	0.82	DW, AL

DATE DUE

Remedial Action Plan
Plan d'Assainissement

Canada Ontario
Canada-Ontario Agreement Respecting Great Lakes Water Quality
L'Accord Canada-Ontario relatif à la qualité de l'eau dans les Grand Lacs